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Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856. Registered at a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXII.—No. 3441] LONDON: FRIDAY EVENING, DECEMBER 9, 1921 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of:—
PLATES, COPPER, FIRE-BOX, FLANGED.

Forms of Tender may be obtained from the DIRECTOR-GENERAL, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Tuesday, the 20th December, 1921.

T. RYAN,
Director-General.

6884

G. R.

FLOATING DOCK FOR SALE WITHOUT RESTRICTION AS TO TRANSFER ABROAD.

The Admiralty have Available FOR SALE a 600 TONS ex-German FLOATING DOCK, at present lying at Sheerness.

Facilities for inspection, together with forms of Tender, &c., may be obtained upon application to the DIRECTOR OF NAVY CONTRACTS, Branch 8, Admiralty, Prince's House, Kingsway, London, W.C. 2.

Tenders are due at the Admiralty by Noon on Friday, 30th December, 1921. 6870

City of Norwich.

The Norwich Corporation invite TENDERS for STEEL SUPERSTRUCTURE and APPURTENANCES of a BRIDGE across the River Wensum at Carrow, Norwich.

Plans, stipulations of contract, specification, and form of Tender may be obtained on the deposit of £25 at my office.

Deposits will be returned on receipt of bona fide Tenders.

Tenders, on the forms supplied, enclosed in sealed envelopes, endorsed "Carrow Bridge," and addressed to the Chairman of the Executive Committee of the Norwich Corporation, must be delivered at my office not later than 10 a.m. on Monday, 2nd January, 1922.

The Corporation does not bind itself to accept the lowest or any Tender.

ARTHUR E. COLLINS, M. Inst. C.E.,
City Engineer, &c.

Guildhall, Norwich,
7th December, 1921. 6866

East Indian Railway.

The East Indian Railway Company is prepared to receive TENDERS for the SUPPLY and DELIVERY of:—

(1) INDIA RUBBER SHEETING, &c.,
(2) WHEEL LATHES,

as per specifications to be seen at the Company's Offices.

Tenders are to be sent to the undersigned, marked "Tender for India-rubber Sheeting, &c.," or as the case may be, not later than Eleven o'clock a.m. on Wednesday, the 21st day of December instant.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By Order,
G. E. LILLIE,
Secretary.

Nicholas-lane, London, E.C. 4,
7th December, 1921. 6900

Romford Rural District Council.
DAGENHAM SEWERAGE.—CONTRACT No. 1.

The above Council are prepared to receive TENDERS for the CONSTRUCTION of about 4000 FEET of 36in. diameter CONCRETE SEWER and other works in the Parish of Dagenham.

Contractors desirous of lodging a Tender should send their applications to the Consulting Engineer, Mr. William Fairley, M. Inst. C.E., Parliament Mansions, S.W. 1, or to Mr. W. J. Grant, Surveyor to the Council, Romford.

Intimation when drawings, specification, and schedules can be inspected will be sent to selected firms.

Tenderers must be in a position to begin operations on or before the 1st January, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

T. W. A. GREENHALGH,
Clerk to the Council.

18a, South-street,
Romford, Essex.
6th December, 1921. 6882

The Danish State Railways invite TENDERS for the SUPPLY of about 20,000 TONS of RAILS and FASTENINGS.

Specifications and drawings can be obtained on payment of 15 Danish crowns on application to "BANEKONTOR, Gl. Kongevej 1, 5 Sal, Copenhagen B, where Tenders will be received not later than 3 p.m. on the 4th of January, 1922. 6850

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

No.		Fee for Specification.
1.	CRANK AXLES AND STRAIGHT AXLES	10s.
2.	WHEELS AND AXLES	£1
3.	ROLLED STEEL DISC WHEELS	10s.
4.	BRASS & IRON OR STEEL SCREWS	1s.
5.	PLATE GLASS, &c.	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Crank Axles and Straight Axles," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 20th December, 1921.

The Directors do not bind themselves to accept the lowest or any Tender.

E. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 7th December, 1921. 6901

The Engineer

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PUBLIC NOTICES

London County Council.
TRAMWAY SUPPLIES, ELECTRICAL EQUIPMENT, &c.

APPLICATIONS are INVITED from firms and particularly manufacturers, for PERMISSION to be PLACED on the LISTS of PERSONS and FIRMS from whom the Council from time to time invites Tenders for the supply of the undermentioned Fittings, Electrical and Mechanical Equipment and Spares, &c., required for the Council's tramways:—

Class No.
1. Car Motors, complete, and Spares.
2. Coils, Armature, Field, and Magnetic Brake.
3. Gear and Pinion Wheels.
4. Armature Re-winding and Repair.
5. Machined Bronze Bearings.
6. Machine-finished Articles (Brass, Gun metal, &c.).
7. Ditto Ditto (Iron, Steel, &c.).
8. Iron and Steel Drop Forged Stampings.
9. Iron and Steel Forgings.
10. Springs for Electric Car Trunks.
11. Iron Castings, Machined and not Machined.
12. Brake Shoes for Electric Car Trucks.
13. Malleable Iron Castings, Machined and not Machined.
14. Steel Castings, Machined and not Machined.
15. Truck Sides.
16. Castings, Brass, Gun-metal, Phosphor-bronze, Aluminium.
17. White Metal and Bearing Alloys.
18. Rolled Steel Bars for Magnetic Brake Shoes.
19. Channels, Angles, and Special Sections.
20. Tyres, Steel, for Tramcars.
21. Car Controllers, complete, and Spares.
22. Controller Fingers, Segments, &c.
23. Canopy Switches, Circuit Breakers, and Spares.
24. Rheostats, complete, and Spares.
25. Pressed Brass and Steel Articles.
26. Carbon Brushes for Tramcar Motors and Generators, &c.
27. Wire, Copper, Cotton Covered.
28. Cable, Electric.
29. Car Furniture and Fittings.
30. Moulded Rubber Articles.
31. Moulded Insulators (other than Rubber).
32. Fibre Articles.
33. Mica and Micanite Articles.
34. Press-spahn.
35. Insulating Varnishes.
36. Foundry Crucibles and Requisites.
37. Transfers, Coach Painters'.
38. Tyres, Rubber, for Motor Vehicles.
39. Electrical Line Equipment (Overhead).
40. Ditto Ditto (Conduit).
41. Copper Bonds.
42. Acetylene Generators and Lamps.
43. Welding Work.
44. Welding Plant and Electrodes.
45. Stone Crusher Rolls, Jaws, &c.

Applications must be made on the official forms, copies of which, together with a statement giving further information on the subject, including the standard conditions of contract, may be obtained from the General Manager, Tramways Department, 23, Belvedere-road, S.E. 1.

In those cases in which Tenders are limited to manufacturers or producers, applications from agents, middlemen or dealers will not be considered.

Firms making application for inclusion in the selected list of tenderers will be informed in due course of the Council's decision in the matter.

Attention is drawn to the fact that, in cases in which the name of a person or firm has been placed on the Council's lists, it is not necessary for such person or firm to apply for forms of Tender, as in all suitable cases forms of Tender will be sent from time to time as issued.

Applications for inclusion in the first lists of selected firms for the supply of the goods and articles enumerated above must be sent in not later than 31st December, 1921. Applications received thereafter will receive consideration in connection with future supplies.

JAMES BIRD,
6823 Clerk of the London County Council.

PUBLIC NOTICES

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—

(1) 90 lb. STEEL RAILS and FISH-PLATES (about 4700 Tons).
(2) C.I. SLEEPERS for 90 lb. Rails (about 6900 Tons).
(3) TIE BARS, GIBS and COTTERS for Ditto (about 1000 Tons.)
(4) COILED STEEL KEYS for Ditto.
(5) 40 lb. STEEL RAILS and FISH-PLATES (about 2700 Tons).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Rails and Fish-plates," or as the case may be, must be left with the undersigned not later than 10 a.m. on Monday, the 19th December, 1921.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 40s. for each copy of Specification No. 2, and 20s. for each copy of Specifications Nos. 1, 3, 4, and 5.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

W. B. REYNOLDS,
For Managing Director.

91, Petty France, S.W. 1,
7th December, 1921. 6909

Wincanton Rural District COUNCIL.
TEMPLECOMBE WATER SUPPLY, CONTRACT No. 1.

The above Council invite TENDERS for the SUPPLYING, TRENCHING, LAYING and JOINTING of about 7300 YARDS of 10 inches, 4 inches, 3 inches, and 2 inches CAST IRON, &c., WATER MAINS; the CONSTRUCTION of a WELL, PUMPING STATION, REINFORCED CONCRETE SERVICE RESERVOIR, &c., and other WORKS incidental thereto, in accordance with plans and specifications prepared by the Engineers, Messrs. A. P. I. Cotterell and Edeon, of 17, Old Queen-street, Westminster, S.W. 1.

Plans and specifications may be seen at the office of the Engineers, 17, Old Queen-street, Westminster, on or after the 9th December, 1921, or at the office of the undersigned, during usual office hours.

Copies of the bills of quantities and form of Tender may be obtained from the Engineers on or after the 9th December, 1921, by intending contractors on payment of the sum of Five Guineas, which will be returned on receipt of a bona fide Tender and all other documents supplied.

Tenders, on the form provided, enclosed in sealed envelopes, must be delivered to the undersigned and endorsed "Templecombe Water, Contract No. 1," not later than 10 a.m. on the 27th December, 1921.

Contractors will be required to provide securities for the due performance of the contract under Section 174 (4) of the Public Health Act, 1875.

The Council do not undertake to accept the lowest or any Tender, but reserve freedom of action.

By Order,
E. N. MARTIN,
Clerk to the Rural District Council.

Wincanton, 3rd December, 1921. 6873

SITUATIONS OPEN

WANTED, Experienced MACHINERY SALESMAN for India by Calcutta firm of engineers. Public school boy preferred. Five years' agreement, pay commencing Rs. 600 a month. No married man will be considered.—Write, Z. J. 236, c/o Deacon's, Leadenhall-street, London, E.C. 3, stating age, experience, and salary required. 6861 A

PUBLIC NOTICES

West Kent Main Sewerage BOARD.
EXTENSION OF MAIN OUTFALL WORKS.

TENDERS are INVITED for the CONSTRUCTION of PRECIPITATION and STORAGE TANKS, SEWER, BUILDINGS, and other WORKS at Long Reach, Dartford.

Drawings may be seen at the offices of the Consulting Engineer, Sidney R. Lowcock, M. Inst. C.E., 6, Queen Anne's-gate, Westminster, or at the offices of the Board, and a copy of the conditions of contract, specifications, bill of quantities, form of Tender, &c., may be obtained from the undersigned upon payment of a deposit of Five Pounds, which will be returned upon receipt of a bona fide Tender, not afterwards withdrawn.

Tenders, sealed and endorsed "Contract No. 4," must be delivered to me, at the offices of the Board, on or before Twelve Noon, Saturday, the 31st December next.

The Board do not bind themselves to accept the lowest or any Tender.

ARTHUR B. COOMBER,
Secretary.

Offices of the Board,
Park House, Bromley, Kent. 6880

SITUATIONS OPEN (continued)

BUSINESS MAN, with Administrative Capacity, WANTED as Executive Assistant for Oil Company in Trinidad.—Send full particulars of experience and references to Box C1050, E.C. News Co., Ltd., 4, Broad Street-place, London, E.C. 2. P4509 A

CENTRAL HEATING AND DOMESTIC ENGINEERING.—REPRESENTATIVE REQUIRED for London and South, with good connection among architects, Commission and expenses.—Write with all particulars to Manager, Heating Dept., the WELL FIRE and FOUNDRY CO., Ltd., 15, Berners-street, W. 1. P4540 A

CIVIL ENGINEER, Fully Qualified, REQUIRED, for inspecting, reporting, improving heavy construction work progress various parts of the world. Good language essential. Splendid opening for gentleman possessing tact, discretion and experience big lay-out. Highest references required.—Communicate in first instance, together with copies record, which will be treated in strict confidence, by letter, to "SOLICITORS," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 6820 A

ENGINEER REQUIRED by SOCIETE HOPKINSON (Valves and Boiler Mountings), 94, Rue St. Lazare, Paris, as ASSISTANT to MANAGER. Applicants must be British, age 28 to 35, with technical and commercial experience, general knowledge Steam Power Plants, and good French.—Applications by letter, giving all particulars and salary required. 6853 A

ENGINEER, with Office and Bookkeeping Experience, REQUIRED for Engineering Repair Works. Give full particulars, age, experience, and salary.—Address, P4518, The Engineer Office. P4518 A

ENGINEER, with Production Experience, REQUIRED for Works in France. Must speak and write French. Young man under 35 preferred. Initial salary £35 to £40 per month.

Write, giving the fullest particulars, copies testimonials, and references.

Address, P4522, The Engineer Office. P4522 A

MACHINE TOOLS.—MANAGER REQUIRED by firm employing 500 men engaged solely upon building special machine tools. Only energetic men of suitable experience, who possess tact, have organising ability, and initiative, need apply. Position is permanent and holds prospects.—Address, P4529, The Engineer Office. P4529 A

REQUIRED for Small Engineering Works in South of England, a live BUYER; must have good experience and knowledge of markets and be able to keep accounts. Sale experience and salary required.—Address, 6866, The Engineer Office. 6866 A

SUPERINTENDENT.—REQUIRED by a Motor Manufacturing Firm in the London district, a general MACHINE SHOP SUPERINTENDENT. Must be thoroughly familiar with up-to-date methods of production and shop practice, and also used to producing work to fine limits. Must also have held similar positions previously.—Address, stating age, experience, and salary required, 6855, The Engineer Office. 6855 A

LONDON REPRESENTATIVE.
WELL-KNOWN SCOTTISH FIRM, Engineers and Founders, require ENGINEER for LONDON OFFICE. Thorough commercial experience and good connection.—Address, stating experience, qualifications, age, salary expected, 6878, The Engineer Office. 6878 A

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THE SERVICES of a GENTLEMAN Trained as an Engineer with good practical experience, chemical or scientific degree and commercial knowledge, are REQUIRED by a manufacturing firm near London; age 30-40.—Address, giving full experience, P4534, The Engineer Office. P4534 A

WANTED AT ONCE, CHIEF MECHANICAL DRAUGHTSMAN for a large Steel Plant and Rolling Mills in the North of England. Applicants must have had good experience in Steel Plant and Rolling Mill work. Preference given to man who has already held position satisfactorily as chief. Good prospects for a really first-class man.—Write in first instance to 6881, The Engineer Office, stating age, experience, present position, when at liberty, and salary expected. Applications treated as confidential. 6881 A

WANTED, DRAUGHTSMAN, with Experience in Centrifugal Pumps and General Engineering Work, for works in south of England.—Address, 6907, The Engineer Office. 6907 A

CHIEF DRAUGHTSMAN REQUIRED, with Broad engineering knowledge, to take entire responsibility of drawing-office.—Apply by letter, stating age, experience, and salary required, to Chief Engineer, TATE and LYLE, Ltd., Sugar Refiners, Plaistow Wharf, Victoria Docks, E. 16. P4520 A

DRAUGHTSMAN (SENIOR), with All-round Experience in Lift Work; only thoroughly competent man need apply. State age, experience, and salary wanted. TRACER also REQUIRED.—Address, P4516, The Engineer Office. P4516 A

FIRST-CLASS DRAUGHTSMAN REQUIRED (in London), with extensive experience in pump designs. Sound theoretical knowledge essential. State full particulars, salary required.—Address, P4528, The Engineer Office. P4528 A

WANTED, First-class FOREMAN, Thoroughly experienced in All-steel Railway Carriage Construction.—Apply, Box 90, Lewis Advertising Agency, Standard Bldgs., Leeds. P4519 A

FOREMAN.—REQUIRED for Large Motor and General Engineering Firm, FOREMAN, capable of taking charge of Grinding Department. Must have held similiar positions previously and be thoroughly acquainted with all up-to-date methods of production and equipment.—Address, stating age, experience and salary required, 6841, The Engineer Office. 6841 A

AN ERECTOR is REQUIRED to Superintend the Erection of Gantry and Overhead Electric Cranes in this country.—Apply, stating full particulars of experience, salary required, &c., to RANSOMES and RAPIER, Ltd., Waterside Ironworks, Ipswich. 6883 A

CHIEF PIECEWORK RATE FIXER REQUIRED, with experience on machine work and assembly of parts for large and small Electrical Switchgear. Applicants should be man with first-rate shop training and ability to set prices which can be maintained. Previous experience in a similar capacity absolutely essential.—Address, 6871, The Engineer Office. 6871 A

SITUATIONS WANTED

BUYING ENGINEER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT. Services available for New Year or possibly before.—Write, Z. M. 619, c/o Deacon's, Leadenhall-street, E.C. 3. 6826 B

CEMENT TECHNICIAN, Trained, Experienced home and abroad, can ACCEPT POST shortly. Abroad preferred.—Address, P4503, The Engineer Office. P4503 B

ENGINEER, A.M.I. Mech. E. (Passed A.M.I.C.E. exam., engineering subjects), is OPEN for PRIVATE WORK; drawings, designs, inspections, tests, preparation for exams., &c. Low fees. Thorough foundry and general engineering experience. Or would consider any progressive position.—Address, P4519, The Engineer Office. P4519 B

ENGINEER, 24 Years of Age, Good All-round Experience, SEEKS START in Drawing-office or commercial side of the business.—Address, P4538, The Engineer Office. P4538 B

ENGINEER (32), A.M.I.E.E., B.Sc., DESIRES executive POST immediately; highly experienced., tech., commercial, with large firms 10 years, home and abroad; structural and maintenance a speciality. Will consider any offers, chief or assistant preferred.—Address, P4484, The Engineer Office. P4484 B

ENGINEER DESIRES Responsible POSITION; home and foreign experience, erection and testing of modern boilers and power plants complete with buildings, ferro-concrete work, &c. Willing to go anywhere. Excellent references; good French and Spanish.—Address, P4511, The Engineer Office. P4511 B

ENGINEER SEEKS POSITION: 9 Years as Foreman in a well-known motor manufacturers in London over chassis erecting, frame dept., steerings, fr. and r. axle, and gear-box depts.; age 24.—Address, P4525, The Engineer Office. P4525 B

FACTORY PLANT ENGINEER: Long Experience, textiles, chemical, power plant, machinery, Languages.—H., 104, Sunningfield-road, Hendon, N.W. 4. P4514 B

LOCOMOTIVE ENGINEER (35), A.M.I.E., 20 years' experience, DESIRES POSITION as Works Manager, Sales Manager, or Representative at home or abroad. Excellent connection with railway engineers in the United Kingdom.—Address, "LOCOMOTIVE," Wm. Porteous and Co., Advertising Agents, Glasgow. P4541 B

REPRESENTATIVE.—ENGINEER, with Exceptional connection in the Midlands, DESIRES APPOINTMENT with first-class manufacturer of engineering products and motor accessories. Commission basis only.—Address, P4482, The Engineer Office. P4482 B

YOUNG ENGINEER (23), G.I.M.E., Urgently DESIRES POSITION with scope preferably consulting, constructional, manufacturing engineers.—Address, P4510, The Engineer Office. P4510 B

YOUNG MECHANICAL ENGINEER (28), B.Sc., A.C.G.I., REQUIRES START with firm in London district, to gain experience.—W. KERRIDGE, 75, King's-road, Chelsea, S.W. 3. P4539 B

£1250 P.A. and Percentage on Results will secure services of fully qualified ENGINEER; complete commercial experience, organiser and develop new or established business, home and export. Conversant all aspects buying, manufacture, costing, sales, publicity; able, fine administrative experience, handle staff and employers.—Address, P4508, The Engineer Office. P4508 B

DRAUGHTSMAN DESIRES EMPLOYMENT Early in the new year, age 30; experience, 7 yrs. rolling stock and vehicle building and design, 7 yrs. mechanical general engineering, the construction of cranes, light structures, and aircraft machine design; willing to adapt himself to something new.—Address, P4537, The Engineer Office. P4537 B

DRAUGHTSMAN (Junior), Served 5 Yrs.' Apprenticeship, motor engineering, technical training (jig and tool office preferred); good refs. proving ability.—C. E. HERBERT, 42, Amberley-road, Bush Hill Park, Enfield, N. P4542 B

SECOND-HAND PLANT.

WANTED.—Two second-hand Diesel Generating Sets, about 150 K.W., 440 volts, direct current.

Must be modern, in first-class condition, and complete with auxiliary gear.

WANTED.—Two second-hand Steam Generating Sets, about 150 K.W., 440 volts D.C., with surface condensing plant.

Two second-hand Water Tube Boilers, about 8000 lbs. per hour evap. capacity, 180 lbs. pressure, complete with feed pumps, all pipework, and superheaters. Must be modern and in first-class condition.

Address, 6832, The Engineer Office.

6832 F

SITUATIONS WANTED (continued)

DRAUGHTSMAN (24), with Good Knowledge of box machinery and wire goods machinery, REQUIRES POST, preferably in Birmingham district.—Address, P4494, The Engineer Office. P4494 B

DRAUGHTSMAN (40) DESIRES BERTH; 5 Years' shops, 20 years' D.O. general experience, 6 years leading draughtsman; London district preferred.—WHITEHEAD, 5, Castletown-road, West Kensington. P4534 B

MECHANICAL DRAUGHTSMAN, with Wide Experience in the design and lay-out of various industrial plants, power station design, &c., DESIRES SITUATION; City office preferred.—Address, P4515, The Engineer Office. P4515 B

FOUNDRY FOREMAN (36), Malleable, Cast Iron, gun-metal, bronze; capable of taking entire control; excellent reference.—Address, P4530, The Engineer Office. P4530 B

SMITHY and FORGE FOREMAN; 12 Years Foreman, marine and general engineering, forging presses, heat treatment, fixing piecework prices, technical training, advanced methods, tactful.—Address, P4469, The Engineer Office. P4469 B

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HOME STUDENTS.—London Matriculation, B.Sc., and A.M.I.C.E. Exams. During studies difficulties arise. Correspondence classes are expensive and possibly you only require occasional individual explanations. We offer you these. Send stamp for particulars.—CONSULTUTORS, 66, Abingdon-road, Kensington, London, W. P4543 B

INST. C.E., Inst. Mech. E., B.Sc., and all ENGINEERING EXAMINATIONS.—Mr. G. F. KNOWLES, M.B.E., B.Sc., A.M. Inst. C.E., &c., personally PREPARES CANDIDATES, either orally or by correspondence. Thousands of successes during the past sixteen years. Courses can be commenced at any time.—69, Victoria-street, Westminster, S.W. Telephone No., Victoria 4780. Ex.

LEARN SURVEYING AND LEVELLING.—Thorough practical instruction given by an expert.—Address, E. MOUL (late L.S.W. and S.P.D. Rlys.), Hollybank, Woking. P4489 B

TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.: 100 per cent. Passes last examination. Estab. 1876.—PENNINGTONS University Tutors, 234, Oxford-road, Manchester. Ex.

MISCELLANEOUS

EXPERT MECHANICAL ENGINEER is Prepared to OBTAIN and REPORT on TENDERS for firms requiring technical assistance.—Address, P4530, The Engineer Office. P4530 B

MECHANICAL ENGINEER (Specialist), with offices in Westminster, is DISPOSED to OFFER FACILITIES to another desiring to commence practice, with minimum capital, and to have co-operation of established consultant without usual partnership.—Address, P4521, The Engineer Office. P4521 B

ROAD CONSTRUCTION AND PUBLIC WORKS.—Well-established FIRM is OPEN to CONSIDER AMALGAMATION or WORKING ARRANGEMENT with sound business of the above nature. Principals or their solicitors only in the first instance.—Write to "E. V." c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 6879 I

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F. JOHNSTONE-TAYLOR, B.Sc., etc., The Bungalow, Underdale Road, SHREWSBURY.

PATENTS

THE OWNERS of PATENT No. 12,826 of 1914, relating to "Improvements in Apparatus for Making Coffee," are DESIROUS of NEGOTIATING with interested parties for the granting of LICENCES thereunder on reasonable terms.—For information apply to Messrs. LLOYD WISE and CO., Chartered Patent Agents, 10, New-court, Lincoln's Inn, London, W.C. 2. 6872 H

IMPROVEMENTS IN MILLING MACHINES, No. 138,819.

IMPROVEMENTS IN VARIABLE-SPEED GEAR, No. 138,812.

THE OWNERS of the Above PATENTS are DESIROUS of ARRANGING by LICENCE or otherwise on reasonable terms for the manufacture and commercial development of the inventions.

For particulars address HERBERT HADDAN and CO., Chartered Patent Agents, 31 and 32, Bedford-street, Strand, London, W.C. 2. 6894 H

THE PROPRIETOR of BRITISH PATENT No. 140,506, dated November 14, 1919, relating to "Improvements in GAUGING APPARATUS," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, 28, East Jackson Boulevard, Chicago, Illinois. 6874 H

THE PROPRIETORS of the PATENT No. 136,155, for "Improvements in or relating to SUBMARINE BOATS," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE and otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to

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For continuation of For Sale Advertisements see page iii

Recent Developments in the Krupp Works at Essen.

THE firm of Krupp's at Essen was founded in 1812, and celebrated its centenary in 1912, when much information of a general character was communicated to various technical journals on the growth of the establishment in the interim. Probably in recent years no single firm has been so much in the mind of the people of Europe as Krupp's, and the armament factory at Essen has excited the keenest speculation. It is now possible to lift the veil of secrecy which covered it recently, and say to what extent it has grown, and also to give some details as to its work during the war.

Essen is on the main line from Cologne to Berlin, and is easily visited from the former town. Essen grew from a small village of 4000 inhabitants to a town with more than 300,000 inhabitants in 1912. It lies in the Rühr Valley among a number of other towns, all of which are employed in industry. This valley is well called the Black Country of Germany.

Krupp's originally was a purely commercial undertaking. Though founded in 1812, it did not make any war material for forty years. In the 'sixties of the last century, however, it developed the built-up gun and the breech-loader, after some Russians had originally proposed to shrink tubes one over the other to get the necessary strength of chamber and barrel. The type of breech-loading gun, then developed by Krupp's, was approved, and used to re-arm the majority of the European armies. Even allowing for this, the output by weight was 85 per cent. of purely commercial material as compared with 15 per cent. of war material. The values, however, were in the ratio of two to one only. The first big financial success of the firm was with the rolling of tires for railway wheels, and the Krupp crest is still three interlaced railway wheel tires.

Before dealing in detail with the Essen works, a few figures can be given to show the amount of work turned out by the firm's establishment as a whole. These include the following works:—The Germania Shipyard, Kiel; the medium-sized gun and shell works at Magdeburg; the rifle factory at Annen; the blast-furnaces at Rheinhausen; and the shell-filling factories at Bottrop and elsewhere; besides proofing ranges, coal mines and smaller subsidiary establishments. The total number of employees at these places during the war was nearly 200,000, and of that total about 100,000 were employed at Essen. The pre-war employees numbered about 40 per cent. of these figures. The original coal mine, used early in the nineteenth century, is still to be seen in the centre of the Essen works. In addition, the firm owns other coal mines, as well as iron ore mines both in Germany and in Spain.

The big blast-furnaces at Rheinhausen can produce about one and a-quarter million tons of pig iron per annum, of which amount about three-fourths are rolled direct at Rheinhausen, whilst the remainder goes to Essen to be treated and converted into steel articles of all types. The employees of Krupp's now number about 40 per cent. of the war-time figures, that is, about the same in number as before the war. Commercial work has to be found for all them. This question will be dealt with more fully later.

The town as a whole is modern and very well built, with good shops, public buildings, &c. It has grown around Krupp's works in a series of garden cities. As is well known, the firm takes a great interest in the social welfare of its employees. The workmen live in colonies or garden cities. Each house has its own garden, and there are recreation grounds, &c., provided for the children. In addition there are co-operative stores, savings banks, hostels, &c., all managed by the firm. A benevolent fund is part of the scheme, and to it the firm makes liberal contributions. Hospitals and convalescent homes are provided for the sick, and special care is taken of the children. There are canteens in the works, and hot meals are served to the workpeople who need them at a moderate cost. The firm claims that these social schemes have produced a very loyal spirit amongst the men, and states that its labour troubles have been very few. During the communistic riots early in 1920 the men apparently remained at work until coerced by the members of the Red army who invaded Essen and held the town for some time. The proceedings of this army were very typical of the outbreaks of that time, as hostages were taken from the principal inhabitants, and there was much indiscriminate looting and shooting. Many mouths afterwards it was difficult to find a sheet of plate glass in Essen which had not been splintered or pierced by a bullet, and many shop windows were boarded up. There is a system of payment in vogue at Essen which is quite out of the usual. In addition to the standard rate per hour, a married man in 1920 got one mark a day extra for his wife and one mark per day for each dependent child. A system of pensions is in practice to which the firm contributes a large sum annually.

As is well known, Krupp's is a limited company, the whole of the shares being held by the Krupp family. Because of this, the close relationships between employer and employee obtaining in a small firm are persisted in, so far as is possible with the enormous number of workpeople involved. The rise in wages in Germany has been continuous, and at Essen wages are at least eight times what they were in pre-war days. As in England, they increased steadily during the war. The standard rate for a skilled man was 80 pfennig per hour in 1914, and it rose to 2 mark 50 pfennig at the time of the Armistice. It is now as high as 6 marks per hour. Certain special men on forges, rolls, &c., get higher wages, and the unskilled man gets less. Piece work is now accepted by the men, although it has only been re-introduced gradually, and this will advance the time rates mentioned above by over 20 per cent. The rise of wages first resulted in reduced output, so shop managers stated, but they are generally of opinion that the output per man is now nearly up to the war-time and pre-war standard. During the war two shifts of ten hours each was the standard. At the revolution, however, a universal forty-eight hour week was insisted upon throughout Germany, and this is still in operation. Overtime is not worked as a rule, but there is no ban upon it if it should be necessary for any particular job. So far as Essen is concerned, the eight-hour day in the shops starts at 6 a.m. and ceases at 2 p.m., if no break is taken for meals. If, however, as is the case in some shops, a mid-day meal interval is taken, then the stopping time is put back by a corresponding amount. Of course, in the foundries, continuous shifts of eight hours each are worked. The workmen like these hours, as they give ample leisure for gardening and other hobbies. Incidentally, there is as yet no equivalent to the modern football match in Germany.

It is now proposed to describe the growth of the Essen works, and to detail the peace-time activities of this establishment.

These works have grown around the original small forge and factory established by Friedrich Krupp in 1812. The coal mine from which he obtained fuel is still in use, although the galleries have had to be sup-

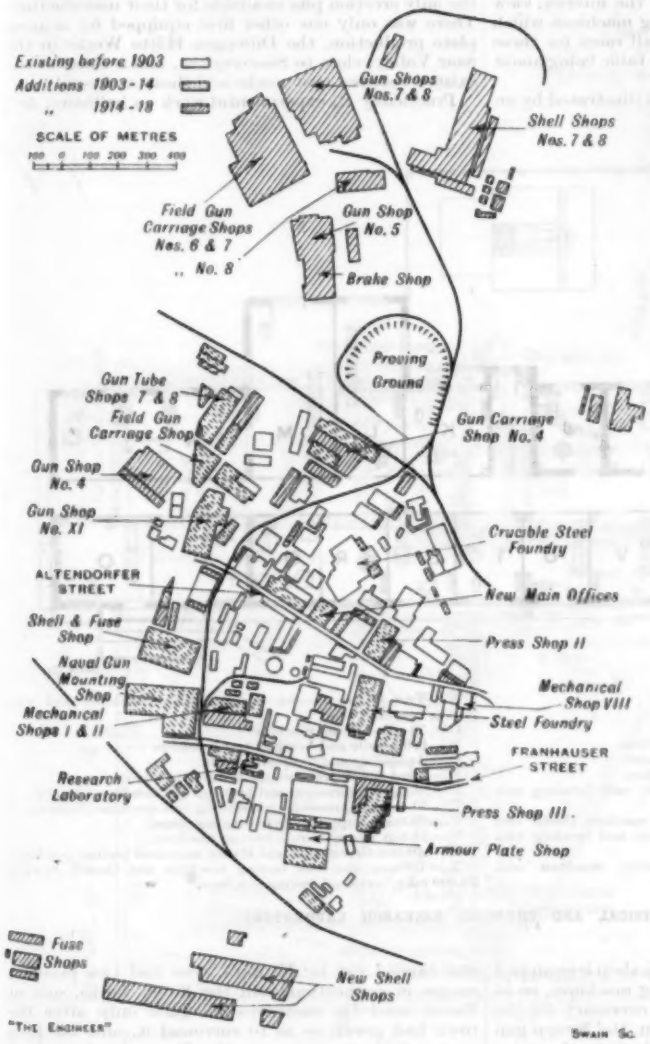


FIG. 1—PLAN OF THE KRUPP WORKS AT ESSEN

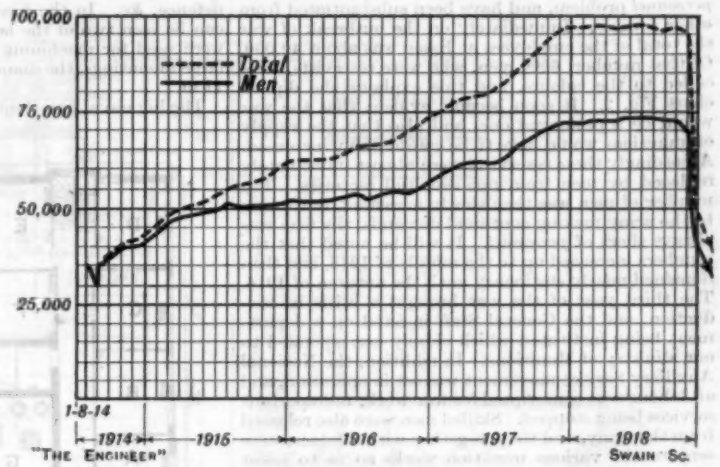


FIG. 2—CURVES SHOWING TOTAL NUMBERS OF WORKPEOPLE

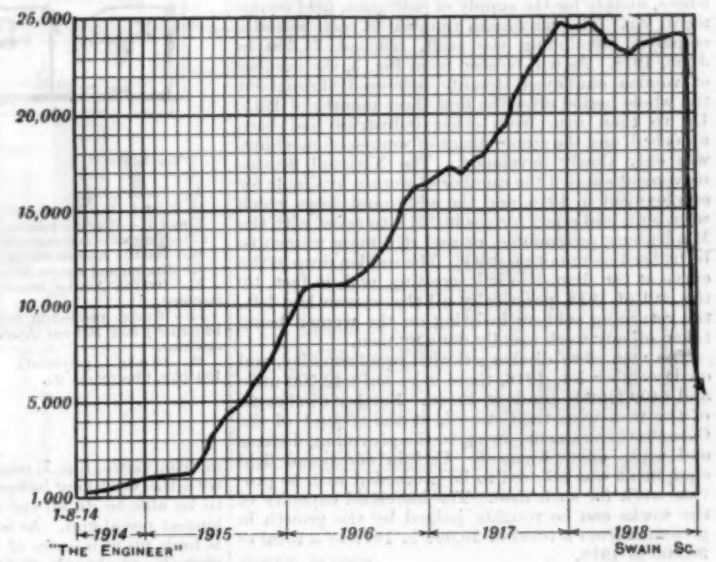


FIG 3—CURVE SHOWING NUMBERS OF WOMEN EMPLOYED

ported by concrete. The growth in area of the works is shown by the following figures :—1861, area covered by factory buildings, &c., 13.5 acres ; 1873, area covered by factory buildings, &c., 86 acres ; 1912, area covered by factory buildings, &c., 232 acres. The periods of growth can be divided into three. The normal expansion which followed the development of the steel industry generally up to about 1900. Then between the years 1903 and 1914 extra shops were built to meet the requirements of the Navy Bill. Such shops were designed purely for the supply of warship material, such as big guns, armour, &c. During the war a large increase was again made. The various stages of development are indicated in Fig 1. When the war ended there were some eighty shops at Essen, and the total floor area was over 2500 acres. The later shops are very fine structures indeed, well-lighted and lofty. Important features are the lifting appliances, which in all shops are in advance of the immediate requirements, and allow for the development in armament on a considerable scale.

With the increase in the number of shops, there was a proportionate increase in the number of employees. The war-time variation in the numbers of workpeople (excluding staff, clerks, &c.) is well shown on the two charts, Figs. 2 and 3. These are from a published account of Krupp's war-time *personnel* problem, and have been substantiated from other sources. Immediately on the outbreak of war the total of the employees at Essen was about 40,000. Of that number, 6000 men, who were reservists, were called to the colours, and this explains the dip on chart Fig. 2. It soon became evident that the war would be a prolonged one, and also that the supply of munitions would have to be considerably increased. Accordingly these reservists were almost immediately replaced by men from non-essential factories. The number of men was then slowly increased, but owing to the army making continual demands, the firm was always short of *personnel*. It will be noted that the numbers increased up to the middle of 1915, and then remained nearly stationary until the autumn of 1916. The third year of the war brought a crisis in production, and the General Staff insisted on a department being instituted which closely corresponded to our Ministry of Munitions. In addition, the National Auxiliary Service movement was set in operation, and all labour was conscripted for war work, unimportant services being stopped. Skilled men were also released from the army, and they, together with dilutees, were sent to the various munition works so as to assist with the Hindenburg programme. Additional shops were also erected during this year at Essen, as elsewhere, mainly for the supply of field guns, field equipment, &c. The maximum number of men actually employed, excluding the staff, reached 74,300 in June, 1918. As will be seen from Fig. 3, the number of women employed steadily increased throughout the whole period after the first three months of 1915. Up to then men from other industries had been absorbed, and the employment of women on machines was only slowly developed. The National Service movement swelled the number of women available for employment in 1916, and the additional shops which were built and ready for use in 1917, to assist with the Hindenburg programme, caused still more women to be utilised on munition work. The sudden drop in the curve at the Armistice is interesting, and, in fact, by the end of 1918, practically all the women had left, the returning soldiers insisting on the women being taken off any work usually done by men.

The men were discharged with equal rapidity, and on December 1st, 1918, there were only 40,500 male and 6400 female hands at Essen. Further discharges of the men were then stayed, at the request of the German Government, owing to the prevailing distress and acute unemployment. Certain additional field equipment was allowed to be proceeded with to provide work for such men. The increased capacity of the works can be roughly judged by the growth in *personnel* from a total of 35,000 in 1914 to a total of 98,000 in 1918.

In connection with this matter, German authorities say that the housing question caused them the greatest difficulty. The number of workmen at Essen was far in excess of the town's capacity for housing, and billeting was not practicable. All ordinary house building was stopped quite early in the war, and there was a shortage of dwelling-houses in all parts of Germany. Accordingly, a series of wooden barracks were erected in the vicinity of all the big munition works. Those at Essen were still in use a long while after the Armistice to accommodate the unmarried men. These barrack towns were complete with dining halls, recreation rooms, and a system of communal living and feeding was in vogue. It is stated that the housing, and, above all, the feeding of the mass of imported labour was more troublesome than any of the technical problems encountered. With the National Service system all labour was conscripted, and the dilutee was as much in evidence as in Great Britain.

As far as Essen is concerned, there was no sign of excessive unemployment during 1920, there being a big demand generally for steel material, both in Germany and adjacent countries. The additional men had by then been drafted back to the districts from which they came, and the occupants of the barracks represented the normal expansion for which no houses were available, consequent upon the complete cessation of building during the war. Incidentally, it may be added, building operations were in progress all over Germany very soon after the Armistice, and the number of new houses, and even factories in hand, was remarkable.

As regards the increase in plant at Essen, which is indicated graphically on Fig. 1, a few remarks as to the shops, &c., may be of interest. To meet the requirements of the Navy Bill of 1906, the following shops, among others, were built. The big naval gun-mounting shop known as Mechanical Shop IX., the gunshop No. XI for the manufacture of the largest-sized naval guns, a new press shop (No. I.), and new steel foundry. Additions were made to the armour plate shop and No. 1 gun shop, and the new offices were erected. The new gun-mounting shop—Mechanical Shop IX.—is a fine building covering an area of over 38,000 square metres. Exterior and internal views are given in Figs 5 and 6, page 622. These illustrations have been reproduced from post-cards purchased in Germany, and were published first at the time of the centenary celebrations of Krupp's in 1912. There have been no very great alterations made to this shop since 1912, but the number of gun-mounting pits has been increased to eight, and each pit is large enough to take a 38 cm. twin mounting for the Baden type. In this shop also the largest land mountings were made for coast defence, &c. In the foreground of the interior view can be seen two of the large planing machines which were used for machining the big ball races for these large mountings, the diameter of the table being about 11 m.

The big naval gun shop No. XI. is illustrated by an interior view—Fig. 7, page 622. This shop is equipped with the very long lathes and boring machines, so as to be able to do all the machining necessary for the longest naval gun. As is well known, the Krupp gun is built up of a series of tubes and jackets, the outer rings being shrunk on to the inner tubes. Some of the long lathes required for machining these tubes are seen in the foreground of the illustration. The big bay containing these long lathes runs at right angles to the main fore and aft bays of the shop. The machine equipment generally can be gauged from the fact that there are in this shop twenty lathes with a length between centres of over 15 m., whilst there are twelve boring machines capable of boring a tube of over 13 m. length. The travelling crane equipment is very good, as can be judged from the picture, the two centre bays each having three travellers with a total lift of over 300 tons, and the other big bay two travellers lifting 150 tons. The big shrinking pit, used for shrinking the tubes together, is enclosed in a corner of this shop. Press shop No. II. is illustrated in Fig. 8, page 622. The presses have a capacity as follows : —Two of 4000 tons, one of 3000 tons, and one of 2000 tons, and there are some eighteen furnaces arranged so as to take the longest propeller crank and other shafts. This shop is about 350ft. long by 200ft. wide, and was fully employed on ordinary commercial work soon after the Armistice.

The principal shops added during the war can be summarised as follows :—Gun shops 7 and 8, for gun tubes up to 21 cm. Gun carriage shops 7 and 8, for carriages up to 21 cm. guns. Gun carriage shop 6, for carriage wheels. Gun carriage and brake shops 3a and 3b. Press shop III. for small shells. Gun shop IV. for 10 and 15 cm. tubes. Shell shops 7 and 8, and unimportant enlargements to existing foundries and press shops. These additional shops are all very well-built, large, airy structures, and a few details about one will give an idea of the whole of them.

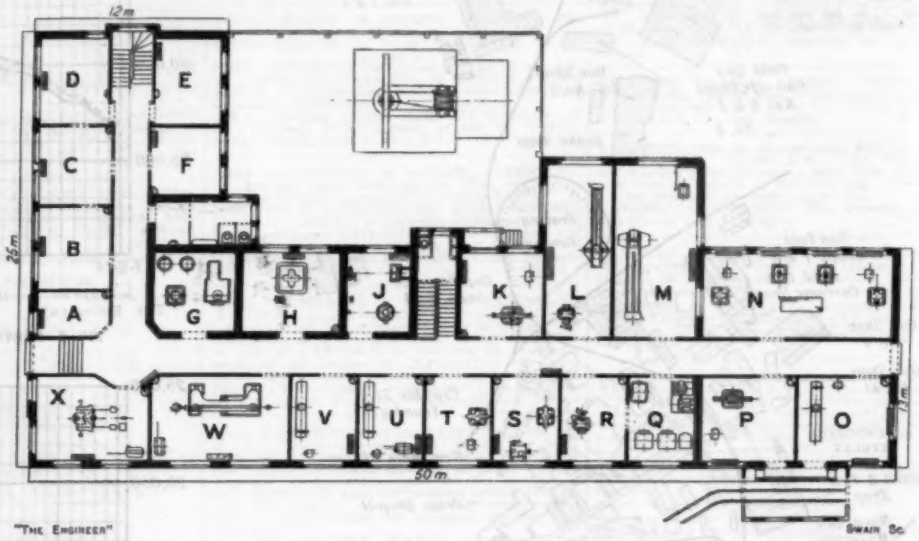
The largest of these shops are the gun carriage shops, Nos. 7 and 8, all under one roof. The floor area is over 70,000 square metres, and it is over 300 m. long by 250 m. broad at the widest part. In this shop are nineteen bays, and each bay has three travellers. It originally contained, when ready for use in 1917, some 1800 machines. It has since been converted into a locomotive shop and re-equipped with machines to suit its new occupation. It may be added that locomotive building was in hand in many shops in in the country, as the shortage of rolling stock was very acute at the end of the war.

When considering the war-time activities of Krupp's at Essen, one must realise the unique position it occupied in Germany. Even more than any armament firm in England it had the absolute monopoly of certain items, being the only firm equipped for their production. For example, whilst Erhardts also produced guns of medium calibre, Krupp's alone could make the big guns both for naval and military use. For the big naval mountings required by the battleships and battle-cruisers, Krupp's had at Essen the only erection pits available for their manufacture. There was only one other firm equipped for armour plate production, the Dillengen Hütte Works in the Saar Valley, close to Saarbrucken, and a close *liaison* existed between that works and those at Essen.

Practically all experimental work on ballistics, &c., was carried out by Krupp's, who had two proofing ranges in connection with the Essen works, one at Essen, used for medium-sized guns only after the town had grown so as to surround it, and the long range at Meppen, close to the Dutch border. It is claimed that the idea of " Big Bertha " originated at Essen, and certainly these guns, and the other long-range guns used for the defence of the Flanders coast, were made at these works. Krupp's also supplied certain trained men to form part of the crew of these big guns.

When intensive munition making was started in Germany, Krupp's gave up the patent rights on all their guns, and supplied drawings to all firms, as well as lending their experts. Many forgings, &c., were also supplied from Essen to other firms to machine. For the " U " boat war, Krupp's were called upon to supply special steel for torpedo bodies, periscope tubes, and armoured towers. At Essen also much general engineering work for the fleet was carried out in the big machinery shops available.

Although, as previously noted, the peace products were greater than the military products in pre-war days, yet in spite of the great increase in staff and plant, all energies were devoted to war materials from 1914 to the end of the war, and the *personnel* was increased by 150 per cent. As is well known, the Peace Treaty has considerably limited the army and the navy of Germany, and also has prohibited the export of war material. Accordingly, the requirements of the German Government will be much reduced, and as that was the only source of orders open to Krupp's and other German munition firms, it follows that they must rely to a much larger extent



A.—Porter's lodge.
B, C, and D.—Workrooms.
E and F.—Waiting rooms.
G.—Hydraulic accumulator and pump room.
H.—200-ton Amsler tensile testing machine.
J.—Marten and Krupp drop testing machine.
K.—100-ton Amsler tensile, compression, and bending test machine.
L.—75 mkg. pendulum impact testing machine (Mohr and Federhoff) and 100-ton Amsler compression and bending test machine.
M.—10 mkg. pendulum impact testing machine and 190 mkg. Charpy do. do.
N.—Two 30-ton Amsler tensile testing machines and wire testing machine.
O.—50-axle testing machine.
P.—100 tensile and bending test machine.
Q.—Annealing and tempering room.
R.—100-ton compression and bending test machine.
S.—50-ton compression and bending test machine (Amsler).
T.—50-ton compression and bending test machine (Amsler).
U.—25-ton Krupp tensile testing machine.
V.—25-ton Krupp tensile testing machine.
W.—40-ton Greenwood and Batley universal testing machine.
X.—100-ton universal testing machine and Grafen Staden 20,000 mkg. torsional testing machine.

FIG 4—PHYSICAL AND CHEMICAL RESEARCH LABORATORY

than in pre-war days on ordinary commercial work to keep them employed in the future. It will have been noticed that even before the war the output in weight was considerably greater for commercial material than for munitions, and one of the problems of the Krupp administration was to convert all its energies to war production. Since the Armistice the other extreme has had to be reached, namely, all peace production, and, as is the case with all munition works, this has not been easy.

The establishment can be roughly divided into three portions:—(*a*) The forge, foundries and ordinary machine shops, which will revert to their pre-war occupation provided sufficient orders are obtained; (*b*) the shops built specially to meet the Navy Bill requirements, which have machinery and equipment designed for the production of big gun and allied work, and which cannot easily be transformed to suit commercial work; (*c*) the shops built in 1916–17 which were to increase the output of munitions in accordance with the Hindenburg programme. Such shops as a whole were designed with a view to commercial use when the war was over, and the change can be readily made.

As regards (*a*), the firm's pre-war specialities, such as large steel forgings and castings for all purposes, railway axles and tires, &c., were in great demand immediately things approached the normal after the Armistice. Not only were the German requirements enormous, but all the neighbouring countries, especially Holland and Scandinavia, became large purchasers. The gradual depreciation of the mark and the relative cheapening of the cost of production which accompanied it, was of great assistance to Krupp's, as it has been to all German industrial firms in the matter of getting orders. It may be said that the steel-producing capacity of Krupp's has been utilised practically to the limit possible under post-war conditions.

The shops under heading (*b*) could not as a whole be economically adapted to ordinary peace requirements, and so have been very little used. The most interesting feature of the peace production development is the use made of the new shops built during the war. The conversion of one of these into a locomotive factory has already been referred to. In others the intention is to specialise in agricultural machinery to meet the German and Russian needs principally, and to compete with the American firms which have had the monopoly so far. One of the new small field gun shops was being modified to suit the production of pneumatic tools, and next to it was a shop to make moving picture apparatus. Close to the big locomotive shop is a locomotive repairing shop. Krupp's also proposed to take up the production of ordinary electric motors and dynamos. In fact, one might say that every branch of commercial engineering was to be exploited to keep this huge establishment with its forty thousand hands occupied.

In this peace-time development the fall in the German exchange has been a big factor. It has practically eliminated the usual competitors and so from all parts of Europe, and, one might add, elsewhere, inquiries and orders have been received for all kinds of manufactured steel items, many of which, in normal circumstances, would undoubtedly have been distributed amongst other countries, and particularly to Great Britain. The progress of Krupp's since the war is a testimony to the fact that if production is cheap there is a sufficient demand to give employment. Although strikes are not unknown, they are very rare indeed just now, but the men have had to be consulted and humoured to an extent which the German director considers is preposterous. However, by keeping the industry in operation, even at the cost of increased wages, there is no doubt that the country as a whole is benefiting enormously.

The rapid progress of Krupp's was due to the extent to which the founders experimented with all new ideas and inventions. Friedrich Krupp started to manufacture crucible steel to compete with the English, and he developed this industry until he could replace it by other methods more economical and more suited to the iron ores available. Other outstanding productions, such as hardened rolls, railway tires, were developed after continuous research and experiment, and the same spirit is manifest to-day. One of the most interesting places at Essen is the research laboratory. This fine building was erected in 1910, and replaced an earlier and much smaller building which dated from 1860. It houses both the physical and chemical sections, and the nature of the equipment can be judged from the ground plan of the physical laboratory—Fig. 4. During the war, the total number of the employees was nearly 300, of which fifteen were men of university training, and 170 had passed the Technical High School course for analysts and experimenters. The analysts on the chemical side and the experimenters on the physical side are recruited from the promising apprentices in the works, who show ability in this direction. Their training includes one year going through special shops, and then they are drafted to the laboratory. In addition to doing the simple work there, they attend lectures in a demonstration theatre, as well as go to the Technical High School in the town for four hours each day. After three years they have to pass an examination before being accepted for the laboratory staff. Even with the cessation of war, this research work will not lag, and one may reasonably expect that Krupp's will continue to develop new steels and new methods of manufacture of the same to compete with the steel makers of this and other countries.

Developments in Power Station Design.

No. XIX.*

AT the Neasden power station of the Metropolitan Railway important extensions are being made to the boiler-house plant by John Thompson Water-tube Boilers, Limited, of Wolverhampton. Six boilers, complete with superheaters, forced draught chain grate stokers, integral economisers and induced draught plant, together with all the necessary accessories and an exceptionally large Kennicott water

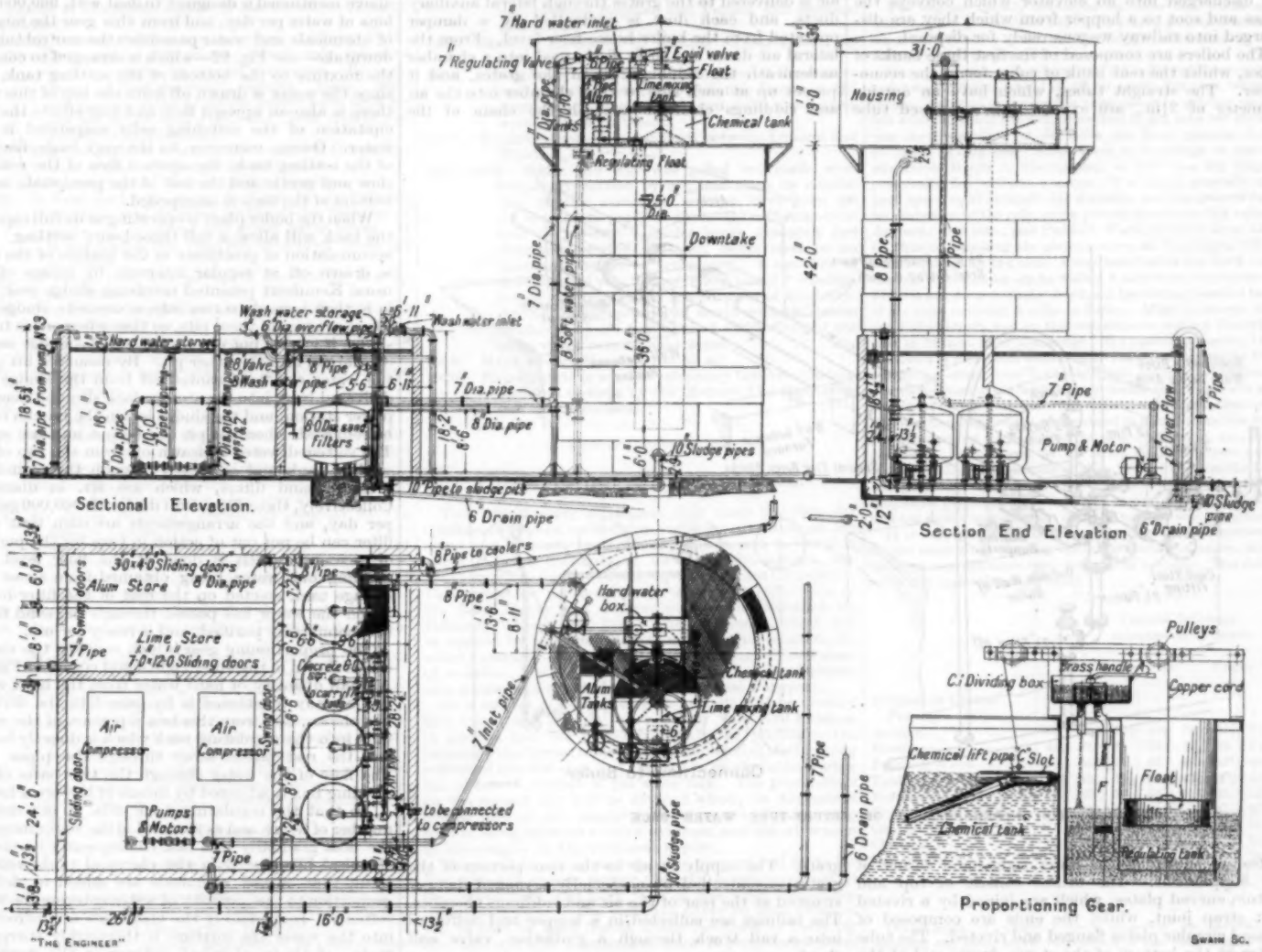


FIG. 92—ARRANGEMENT OF NEW WATER SOFTENING PLANT AT NEASDEN POWER STATION

softener, are at present being installed by this firm, which was awarded the contract after very careful consideration had been paid to the merits of the Thompson boiler by the company's engineers and the main contractors, the Metropolitan-Vickers Electrical Company. Although it was recognised that the installation of these boilers would incur considerable expense, on account of it being necessary to remove existing foundations and to raise the roof to accommodate the vertical tube units, it was decided that the inherent advantages of Thompson boilers would amply justify their employment. From the Supplement which we publish with this issue it will be seen that the six boilers are arranged in three batteries, and as it was necessary to secure the largest output with the available space, which was determined by the pitch of the existing coal bunker stanchions, two of the boilers have been designed for a larger evaporating capacity than the remaining four, which have an individual heating surface of 6250 square feet, and an evaporating capacity of 25,000 lb. per hour. One of the other boilers has a heating surface of 7000 square feet and evaporates 27,720 lb. of water per hour, whilst the corresponding figures for the sixth

*No. XVIII. appeared December 2nd.

boiler are 7560 square feet and 30,200 lb. respectively, the heating surfaces of the integral economisers being excluded in each instance. These integral economisers, we may mention, have already been employed in connection with other of the firm's contracts, and have always given entire satisfaction.

Each boiler is designed for a working pressure of 275 lb. per square inch and a final superheat temperature of 650 deg. Fah. Two forced draught chain grate stokers are fitted to each boiler, the grate area of those belonging to the 25,000 lb. boilers being 148 square feet, that for the 27,720 lb. unit 165 square feet, and for the largest 30,200 lb. unit 179 square feet. The boilers are being erected on a floor built up of steel joists and channels, so as to provide a basement underneath for the easy removal of ashes and soot. The ashes fall into large hoppers underneath the rear of the stokers, and they are discharged from these hoppers into bogie wagons running on 2ft. gauge rails. Ample provision is also made for the removal of the soot, which, on account of the straight boiler tubes, does not settle on the heating surfaces, but falls into large hoppers underneath the boilers in the same manner as the ashes, and is also discharged into bogie wagons running on the rails. These wagons containing the soot and ashes are wheeled outside the boiler-house, where the contents are discharged into an elevator which conveys the ashes and soot to a hopper from which they are discharged into railway wagons ready for disposal.

The boilers are composed of the first three banks of tubes, whilst the rear bank of tubes forms the economiser. The straight tubes, which have an outside diameter of 3¼in., are expanded into pressed tube plates, as shown in the lower right-hand corner of our Supplement. The drums consist of top and bottom-curved plates, which are joined by a riveted butt strap joint, whilst the ends are composed of pressed circular plates flanged and riveted. The tube plates at the bottom of the steam drums and at the top of the lower drums are pressed with a series of flats, which are arranged so as to maintain an almost perfect circularity of the drum and an even resistance to internal pressure. The tubes are composed of solid drawn mild steel, and are expanded into the holes bored in the flats. After the feed water has been treated by a Kennicott water softening plant it enters the boilers by way of the feed valves at the rear top drum, which constitutes the top of the economiser, and which contains a division plate for causing the water to descend down half of the tubes and into the mud drum, from which it afterwards rises into the other half of the tubes and finally returns to the other side of the steam drum. As will be seen from the Supplement, there is no connection between the two rear mud drums, and consequently the water from the integral economiser enters the boiler proper through the bottom circulating tubes of the two rear steam drums, the water having first passed completely through the economiser in the manner described. The steam is released from the rear steam drum in which there is the least ebullition, and it is conveyed from the receiver to the superheater,

In accordance with standard practice, the superheaters on all the boilers are placed between the first and second banks of tubes, and they are intended to give at present a final steam temperature of 540 deg. Fah. at a pressure of 180 lb. per square inch, but when the pressure is raised at a later date to 275 lb. per square inch, the temperature will be increased to 650 deg. Fah. The tubes of the superheaters are expanded directly into the headers, which, like the tubes, are composed of the best solid drawn steel. Opposite the ends of each tube, stoppers are provided to allow easy access for expanding the tubes and repairs. All the boilers are fitted with Bennis horizontal forced draught chain grate stokers, specially adapted for burning low-grade fuels with forced draught and having varying widths and grate areas to suit the respective boiler capacities, there being a pair of grates for each boiler; and to prevent air entering the furnaces at places other than that desired, the stokers are completely housed in at the front and sides.

Doors are provided to give easy access to the front of the grates to facilitate inspection and repairs, and they are controlled by a simple operating device which, when the doors are closed, effectively seals them. The air is supplied to the furnaces by two 45in. diameter double-inlet Sirocco fans, each having a capacity of 75,000 cubic feet per minute at a pressure of 3in. water gauge, one fan being situated at each end of the range of boilers, and from the fans the air is delivered into a common air duct above the fans in the basement of the boiler-house. The air is delivered to the grates through lateral auxiliary ducts, and each duct is controlled by a damper operated from the boiler-house floor level. From the lateral air ducts the air is discharged into a chamber underneath the riddlings pit of the grates, and it passes up at each side of that chamber into the air and riddlings chamber beneath the chain of the grate. The supply of air to the rear portion of the grates is controlled by a specially arranged damper situated at the rear of the air and riddlings chamber. The tailings are collected in a hopper and delivered into a rail truck through a guillotine valve and shoot.

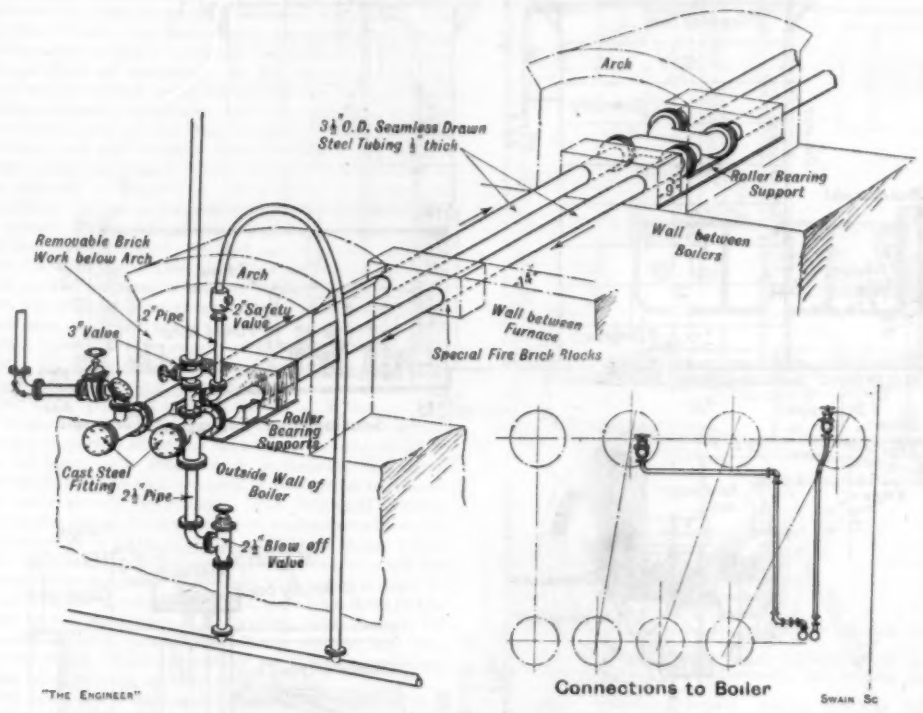


FIG. 93—ARRANGEMENT OF RETURN-TUBE WATER BACK

A departure from orthodox design has been made by the provision of a "return-tube water back" just above the rear end of the chain grate stokers the object of the arrangement being to compress the fuel on the bed of the grate without forming a cake or clinker at the rear end, so as to provide a complete air seal for the ashpit, whilst at the same time permitting the ashes to pass continuously from the grate into the ash hopper. This so-called "water back"—see Fig. 93—is composed of two solid drawn steel tubes ½in. thick, which are connected in series with two drums of the boiler so that they are always full of water and cannot therefore overheat. Two quick-acting valves, which are operated from the floor level, are provided for cutting out the arrangement if necessary. The usual safety valves and blow-down valves are, of course, also provided. All the grates are driven by a roller chain from an overhead line shaft and through a Bennis six-speed gear-box fitted with a safety device for throwing the gear out automatically in the event of the grates being jambed. Each pair of boilers is connected to a single self-supporting chimney, and each chimney is provided with two Sirocco electrically driven induced draught fans, so that each fan deals with the gases of a single boiler. The chimneys stand approximately 100ft. above the ground level, and are lined with fire-brick for a distance of about 50ft. In the flues there is a by-pass arrangement so that the gases from the boilers can, if necessary, be discharged directly into the chimneys without passing through the fans.

The Kennicott water softening plant, which is to be used in conjunction with these boilers, and which is being installed by the Kennicott Water Softener Company, Limited, is shown in Fig. 92. Where water is the least hard or impure a softening plant is, of course, essential in order to secure efficiency and long life of the boilers. In this particular instance, the plant consists of a complete "K" type Kennicott softener, four Kennicott pressure sand filters, complete with a centrifugal pump and motor, soft wash water storage tank, hard water sump, and the buildings for the filters, pumps, chemical storage and compressors. Complete pipe work, ranges and sludge pits are also being provided by the makers of the softener. Hard water drawn from wells is delivered into a hard water sump, which is sunk in the floor of the filter-house under the pumps. From this sump the water is pumped to the hard water box of the proportioning gear on top of the settling tank which forms the main body of the softener. When the softening chemicals have been accurately proportioned to the incoming water they are intimately mixed with the water by means of a mechanical agitator, worked by the impetus of the filling water. These chemicals consist of a mixture of alumino-ferric and lime. The proportioning gear above mentioned is designed to deal with 960,000 gallons of water per day, and from this gear the mixture of chemicals and water pass down the central tube or downtake—see Fig. 92—which is arranged to conduct the mixture to the bottom of the settling tank, and since the water is drawn off from the top of this tank there is also an upward flow and this effects the precipitation of the softening salts suspended in the water. Owing, moreover, to the very large diameter of the settling tank, the upward flow of the water is slow and gentle and the fall of the precipitate to the bottom of the tank is unimpeded.

When the boiler plant is operating at its full capacity the tank will allow a full three-hours' settling. The accumulation of precipitate in the bottom of the tank is drawn off at regular intervals by means of the usual Kennicott patented revolving sludge gear, and it is then caused to run into a concrete sludge pit. There are two of these pits, so that when one is full of sludge it can be put out of use and the sludge can be discharged into the other pit. By means of lift pipes the water can be decanted off from the sludge and delivered back into the storage lake situated near the power station, and the sludge left in the pit can easily be removed, when the pit can be put into use again. The softened water is drawn off from the top of the settling tank and is passed through the cylindrical pressure sand filters, which are 8ft. in diameter. Collectively, these filters will deal with 960,000 gallons per day, and the arrangements are such that each filter can be put out of action in turn for the purpose of cleaning, which is done at the floor level, the washing out water being obtained from a cast iron storage tank erected on the roof of the filter-house. When the water has passed through the sand filters it is completely purified, and is ready for use.

The proportioning gear which controls the chemicals is shown in the lower right-hand corner of Fig. 92. A small quantity of hard water from the hard water box already mentioned is by-passed to the dividing box shown, and from this box a portion of the water falls into the regulating tank which is directly below, and the rest passes away through the pipes E F. The flow of the water through the two parts of the dividing box is adjusted by means of the brass handle A, so that the regulating tank fills up in a definite number of hours, and as the level of the water increases the float gradually lifts and consequently lowers the chemical lift pipe C in the chemical tank, with the result that mixed chemicals are added in definite proportion to the quantity of water entering the water softener. Immediately the chemicals are introduced into the water the mixture is thoroughly stirred by means of the mechanical agitator in the downtake in which the water descends and finally flows upwards outside the downtake in the manner described. All the power for operating the plant is supplied by the water wheel which, in addition to driving the agitator in the downtake, also operates a four-bladed agitator in the chemical tank, so that the chemicals are constantly and thoroughly mixed.

In the course of a discussion upon ironfoundry problems at a meeting of the Manchester Metallurgical Society, on November 22nd, Mr. S. Evans remarked that in comparison with American irons British irons appeared to be lacking in toughness. He had heard that the same phenomenon was observed with German irons, which were tougher than British of approximately the same analysis. Why was that? Mr. E. L. Rhead, who had opened the discussion, replied that many American irons owed their extreme toughness to their freedom from sulphur and phosphorus. They were made from hematite, which was of great value in securing toughness. But only in exceptional cases were German irons tougher than British brands. Possibly the variation was due to the presence of some ingredient not usually included in the analysis. For instance, he had found aluminium, calcium, and titanium, and the presence of those ingredients, even in small quantity, would produce a marked difference in the properties of irons which otherwise appeared to be of the same character.

A Chronology of Communication.

By C. F. DENDY MARSHALL, M.A.

NOTE.—*The word "communication" is used here for the exchange or transmission of messages or information only not in its more extended meaning. The subject of locomotion was treated in a similar manner in* THE ENGINEER *for June 27th and July 4th, 1919.*

PERHAPS the most primitive means of conveying news to a distance is the use of beacon fires as warnings of danger, which is mentioned by Homer, and was used in this country down to at least as late as the Tudor period. An organised system of this nature was prepared against the coming of the Spanish Armada.

In very ancient times regular posts were established for the purpose of conveying Government messages only. Instances are recorded of systems of this kind being set up in Persia by Cyrus, in Italy by Augustus, and in China, the last named, according to Marco Polo, employing no less than 200,000 horses.

During the earlier part of the Christian era, various systems of Government posts existed in Europe. A postal system in the modern sense of the word, attached to the University of Paris, was in existence as early as the thirteenth century, for the abolition of which in the eighteenth large compensation was paid.

The use of homing pigeons for carrying dispatches is of very remote antiquity. The ancient Greeks conveyed the names of Olympian victors to their various cities by that means.

Sixteenth Century. Down to the reign of Henry VIII., both public and private letters only travelled in this country by special messenger. By command of that sovereign, regular "posts" were set up, *i.e.*, stations where horses were kept for the use of the king's couriers. This system was extended by Elizabeth.

1635. Regular posts were set up for the use of the public, with a scale of charges by distance.
1637. A "letter office" was opened in London.
1653. A local post was set up in Paris by de Valayer, which is said to have included the features of post-paid envelopes and street letter boxes. It is not known how long this enterprise continued in action.
1680. A penny post was set up in London by Murray and Dockwra.
1688. The Post Office packet station at Falmouth was established.
1784. The carriage of letters transferred to coaches, on the proposal of John Palmer.
1791. Semaphore or aerial telegraph invented by Chappe in France.
1793. "Telegraphy" by means of semaphores was practised during the French Revolution.
1798. Bethancourt, using the discharge of a Leyden jar, transmitted messages between Aranjuez and Madrid, over twenty-five miles.
1809. Electro-chemical telegraph invented by Soemmering. In 1810 he made a bell ring 2000ft. off.
1815. Sir Home Popham's semaphore adopted by the British Admiralty.
1816. Francis Ronald laid down eight miles of insulated wire to carry out his system of telegraphing. A model of his apparatus is in the Victoria and Albert Museum.
1818. Night semaphores, for land and sea, introduced.
1830. Mails first sent by railway—Liverpool and Manchester.
1835. Mails to India sent by the Overland route, owing to the energies of Lieut. Waghorn.
1835. Morse constructed a rough working model of an electric telegraph in America.
1836. Cooke and Wheatstone invented an electric telegraph in which an alphabet was worked out by the movements of three needles.
1837. Earliest practical trial of electrical telegraphy on the London and Birmingham Railway.
1837. Alfred Vail, of U.S.A., invented a printing telegraph.
1838. Mails conveyed to America by the steamship Sirius.
1838. The first "travelling post office" commenced running.
1838. Signals were communicated by a pneumatic tube between Euston and Camden Town, on the London and Birmingham Railway.
1840. Inland penny postage established, in consequence of the activities of Rowland Hill.
1842. "Submarine" telegraph experiments under the Serpentine.
1843. First public telegraph line laid, from Paddington to Slough on the Great Western Railway, under the patent of Wheatstone and Cooke.
1843. First American electric telegraph, Washington to Baltimore.
1846. Incorporation of the Electric Telegraph Company.
1846. Electric dial telegraph patented by John Nott.
1846. "Electric Telegraph Company" formed.
1848. First year of Admiralty electric telegraph.
1851. A cable was laid between Dover and Calais.
1853. The "Pneumatic Dispatch" system, invented by Latimer Clark, was applied between two of the London offices of the Electric and International Telegraph Company.
1853. Reuter's telegrams organised.
1855. Invention of the Hughes type-printing telegraph.
1857. Failure of first attempt to lay Atlantic cable.
1858. An Atlantic cable was laid, which, however, only proved serviceable for two months.
1860. Reis invented and constructed a rudimentary telephone.
1863. United States Army employed electric wires on the field of battle.
1866. Successful laying of two Atlantic cables.
1870. Inland telegraphs taken over by the Post Office, a monopoly being conferred by Act of Parliament.
1870. During the Franco-Prussian War a pigeon post was organised, the letters being photographed on a greatly reduced scale. Many letters were also carried by the balloons sent out of Paris.
1874. Baudot multiplex system of telegraph working.
1876. Graham Bell's patent for the telephone.
1878. First telephone exchange opened in London.
1878. Invention of the microphone by Hughes.
1879. A pneumatic system of letter post established in Paris.
1881. In the Waziri Expedition communication by heliograph was maintained up to a distance of seventy miles.
1882. Experiments were carried out by Graham Bell, in the course of which signals were transmitted a distance of a mile and a-half between boats on the Potomac River, through the water without wires.
1885. Preece produced wireless telephonic communication by inductive methods.
1889. Various telephone companies in Great Britain were this year united under the name of the National Telephone Company.
1891. Telephonic communication opened between London and Paris.
1895. Communication established between Crookhaven Post Office and the Fastnet Lighthouse on a system of non-continuous cable by Willoughby Smith.
1896. The Post Office purchased the trunk lines of the National Telephone Company.
1898. Parcels conveyed by motor mail vans.
1898. Wireless stations on the Marconi system were established in the Isle of Wight and Bournemouth, followed the next year by communication between England and France, and between two ships.
1901. Marconi succeeded in sending signals across the Atlantic.
1904. A regular system of communication of Press news and private messages to Atlantic liners on the journey was inaugurated, and daily newspapers were printed on board.
1911. Experimental aeroplane post, between London and Windsor.
1914–1918. While the war was going on, mails were frequently carried by air, and since its conclusion regular aeroplane services have been set up in various parts of the world. Communication by wireless was also much extended and developed during the war, being used to an enormous extent on aeroplanes. A new line of development was that of "directional" wireless, which was brought to a high state of efficiency. An interesting method of secret communication employed at sea was devised which utilised the ultro-violet rays of light alone.
1919. Mails crossed the Atlantic by air.
1920. Experiments in wireless telephony between Chelmsford and Geneva by the Marconi Company were partially successful.

FORTHCOMING AIR CONFERENCE.

THE Air Ministry announces that since the first Air Conference proved so useful in focussing attention on the many and intricate problems of aviation and in bringing about a frank exchange of views on the subject, the Air Council has decided to call together another Conference. This second air parliament will be held, by permission of the Lord Mayor and Corporation, at the Guildhall on February 7th and 8th, 1922. The Conference, which will be opened by the Lord Mayor, will, on this occasion, be asked to address itself mainly to the question of the future of aviation, with special reference to its development as a regular and speedy form of commercial transport.

As a matter of convenience the papers will be divided into two main groups, one dealing with civil aviation in general and the other with technical problems, the papers on the former subject being delivered at the morning session of the first day, and the papers on the latter during the afternoon session of the same day. The proceedings on the second day will be devoted wholly to discussions arising out of the previous day's papers, the morning session being allotted to civil aviation, and the afternoon to discussions on the technical papers.

There will be two chairmen: the Secretary of State for Air, who will preside during the civil aviation portion of the proceedings, and Lord Weir of Eastwood during the technical sessions. The principal paper on civil aviation will be read by Lord Gorell, Under-Secretary of State for Air, who will give a general account of progress at home and abroad and will direct attention to a consideration of the ways and means whereby the development of civil aviation at home and in the Empire may be best furthered; in this connection Lord Gorell will endeavour to enlist the practical co-operation of business and other interests. The main technical paper will be read by Mr. F. M. Green, of Sir W. G. Armstrong, Whitworth Aircraft, Limited. The names of the other speakers will be communicated later.

BRIDGE ACROSS SYDNEY HARBOUR.

TENDERS for the construction of a bridge over Sydney Harbour were called for in the New South Wales Government *Gazette* of Oct. 8th, and the local Press. Similar announcements will in due time be published throughout the world, and it is reported that the Government of New South Wales intends to send the Chief Engineer of the State, who has designed the bridge, to Canada, the United States, and Great Britain during the coming year, where he will afford any information required. This undertaking, which has been talked of for many years without practical result, is of considerable magnitude. The New South Wales Government *Gazette* notice calls for tenders for a bridge, which is to be of the cantilever type and will reach from Dawes Point, on the south side of Sydney Harbour, to Milson's Point, on the north, and will comprise a span of 1600ft. clear from the centre of the main piers. The total length to be tendered for is 3816ft. The deck is to accommodate four lines of railway and a roadway 25ft. wide between trusses. There are also to be a footway 15ft. wide, cantilevered outside the western side, and a motor roadway 18ft. wide on the other side. When this bridge is erected the transcontinental limited express will start from Rockhampton, Queensland, and will pass through Sydney, *viâ* the bridge, in the course of a run of 4020 miles. During the past twenty years the passenger traffic across Sydney Harbour, which will be served by the new bridge, has increased from 16,500,000 to 41,000,000 per annum, or practically by 150 per cent. We understand that the tenders must reach the Under-Secretary for Public Works, New South Wales, not later than October 31st, 1922.

Letters to the Editor.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

LOCOMOTIVE PERFORMANCES.

SIR,—In your series of footplate experiences on various railways, for some reason you omitted the South-Eastern and Chatham Railway. As I recently have had opportunities to time several runs of the express trains in the Folkestone service, it is just possible your general readers will be interested in the details.

The distance, London to Folkestone, is exactly 70 miles, and the trains are timed to do this journey in both directions in 90 min. The 11 a.m. ex Folkestone Central is timed to do the 70 miles in 85 min.

The engines usually employed on these fast trains are the latest type 4–4–0 built in 1914, and I have generally found that when exceptionally one of Mr. Wainwright's locomotives, "740" class, are used they cannot run to time.

On a recent run, with locomotive 778, with eight bogie carriages and two Pullmans, equal in all to about 310 tons behind the tender, we were rather longer than usual in getting up speed, but after Sandling the engine seemed to get into her stride and was soon travelling at 70 miles per hour, passing Ashford, 14 miles, in 20½ min. From there to Tonbridge is one of the straightest tracks in the country, as there is a 26½ miles run, practically flat without a curve. The trains generally keep a good speed right through this distance, and the present run was no exception to the rule, as we passed Headcorn, 10¼ miles from Ashford, in 10 min., and Paddock Wood, 21 miles from Ashford, in 19 min., reaching the serious curve at Tonbridge, 26½ miles from Ashford, in 24¼ min. From here begins the hard work, as there is a stiff climb up to within a mile from Sevenoaks; but 778 did not seem to find it hard, for her timing was the best out of six runs, covering 5 miles in 9 min. After Sevenoaks there is the Polhill climb, and on this occasion we reached the 18¼ milepost in 20 min. from Tonbridge. We passed Orpinton, 14 milepost, in 27¼ min. from Tonbridge. This only represents 34 miles per hour average from Tonbridge, but, judging by performances of other locomotives with lighter loads, this was quite a good timing on this occasion. To Chislehurst from Orpington is 2¾ miles, and this length was covered in 2¼ min., and the 8¼ milepost was passed 5¼ min. after passing Chislehurst, *i.e.*, 63 miles per hour. From there, as on every run, there were constant signal checks; but in spite of them we arrived outside London Bridge 2 min. before the time due at Cannon-street, a most creditable performance considering it was only an ordinary run and the driver was unaware that the journey was being timed.

It is very noticeable that on the whole the locomotives keep to the same times for the various stretches of route, although different engines have their individual timings. The following table will make this more clear.

	Mls.	Various journeys, minutes after start.							
		Engine 740.				Engine 778.			
Folkestone Central ..	70	—	—	—	—	—	—	—	
Passing—									
Ashford	56	19½	19½	18½	19½	21½	21	20½	
Headcorn	45½	21	21	20½	21	22	21	—	
Paddock Wood	35	40½	41	40	40	42	40½	39½	
Tonbridge	29½	46½	47½	46	47½	47½	46	44½	
Entrance to River Tun'l	24½	56	56	55	57½	56	55½	53½	
Entrance to Polhill Tun.	18½	65½	65½	64½	67	67	66	65	
Orpington	14	72½	72½	71	*	75	73	72½	
Chislehurst	11¼	75½	75½	73½	*	77½	75½	74½	
Mile-post	8¼	78	78	*	*	80½	78	77½	

* Slowed.

Other runs, of which I have, however, no records, have included the locomotive 761, which is the only engine I have ever found able to get its train to London on time. All the above runs meant an arrival 6 min. to 15 min. late. There seems to be something very faulty with the timing of trains in the early morning into London, as they seem to be late. It may be the drivers' fault, for, as already stated, 761 engine seems to get in to time always.

A. P. SCHOVE.

December 5th.

LOCOMOTIVES WITH FOUR EXCENTRICS.

SIR,—Amongst engineers interested in the history of locomotives it is generally accepted that the first locomotive to be fitted with four excentrics was built by William T. James, of New York, for the Baltimore and Ohio Railroad in 1832. Not only so, it is further accepted that the ends of each pair of excentric rods were connected by a link which, through a die, transmitted the movement to the valve spindle and so constituted the first "link motion" reversing gear. This locomotive was developed from a three-wheeled steam road carriage previously built by the same maker in 1829 and which also was fitted with four excentrics.

In any case the use of four excentrics with fork gab excentric rods was patented by Messrs. Norris and Long on January 17th, 1833, the arrangement being as shown on the Philadelphia, illustrated in "The Locomotive and its Development," by C. E. Stretton. If, however, Stretton is correct in the following statement, then the use of four excentrics on a locomotive first took place in 1826, although it must be recognised that the four excentrics only duplicated the functions of two.

Referring to Stockton No. 5, of the Stockton and Darlington Railway, Stretton states:—"During the early part of the year 1826 Messrs. Wilson and Co., of Newcastle, designed and constructed an engine, No. 5, for the Stockton and Darlington

Railway, and as that firm considered outside coupling rods an objection, they placed their engine upon four wheels and employed four cylinders, two to each pair. Thus the locomotive had two pairs of independent driving wheels, a plan more recently used upon the North-Western Railway."

This statement is evidently intended as an amplification of the statement made in "Locomotive Engineering" by Zerah Colburn as follows:—"This engine had four cylinders, two to each pair of wheels, and appears to have been the first in which a single pair of wheels was worked by two pistons acting upon cranks at right angles to each other. The last-named arrangement is one of great consequence in all locomotives, and it is singular that its first adoption has heretofore escaped inquiry."

In their conclusions regarding the arrangement of this engine neither of these writers appear to have paid much attention to the state of the art of locomotive building in 1826. Locomotion No. 1, built in the previous year, had two cylinders and required for its manipulation one regulator handle and four valve handles. An independent driver engine would be the equivalent of two such engines, and would have had no less than ten handles. The absurdity of such a complication is evident. Stockton No. 5 was a four-cylinder engine, but it had the piston-rods of each pair of cylinders cottered to the same crosshead, the cylinders being placed one on each side of the boiler, over each pair of wheels. The two cylinders over each pair of wheels had their slide valves operated in unison by a rocking shaft; the crank pins in the wheels were placed on coincident centres and the two pairs of wheels were coupled by outside rods and return cranks exactly as Locomotion No. 1 was coupled. There were consequently only two excentries required on the engine. It was the desire to remove the cylinders from the objectionable position on top of the boiler, and not an objection to coupling rods that prompted the design of Stockton No. 5. Swiftsure, built by Messrs. Forrester and Co. for the Liverpool and Manchester Railway in 1834, had only two excentrics, Fig. 13 of my article in The Engineer, July 2nd, 1920, being a detail of the gear.

Glasgow, December 3rd. JAS. DUNLOP.

Sir,—Referring to Mr. E. A. Forward's letter in The Engineer of December 2nd, I have failed to find Mr. Alexander Allan's particulars in Vol. 51, page 159, of this journal—possibly owing to the reference numbers being incorrect—and I am therefore unable to comment upon them. I have in my possession a number of original letters from Mr. Allan, in one of which he gives several particulars of Forrester's engines. He mentions the valve gear, but does not describe it, beyond referring to vertical excentric rods. It is curious that no mention is made of four excentrics. This, however, is merely negative evidence and, of course, does not prove that Forrester's engines had not four excentrics.

Mr. D. K. Clark, in "Railway Machinery" (1855), page 21, illustrates Forrester's valve gear of 1834 with vertical excentric rods. This illustration distinctly shows one excentric only. The description in the text states:—"*The eccentric* acted vertically; it had two diverging rods finished with gabs, and these were placed in gear with the double spanner on one side or the other, or held out of gear by a double-ended pall hung betwixt them, and worked from the footplate. It would therefore appear that if Forrester's Swiftsure had four excentrics, D. K. Clark's illustration and description of the valve gear cannot be correct.

On page 22 the same writer states that "the first application of four eccentrics to locomotives was made by Messrs. Hawthorns, of Newcastle, in 1837." The writer of this letter has always understood that this statement is correct, so far as Messrs. Hawthorn's name is concerned, though the date should have been 1835, and the statement needs the qualification that it applies to locomotives built in this country. Zerah Colburn pointed out that four excentrics had been previously used in America.

In a communication made to the writer some time ago Messrs. R. and W. Hawthorn, Leslie and Co. claimed that the Comet of 1835 was the first engine to have four fixed excentrics. According to Colburn, no patent appears to have been taken out for this improvement, at least in this country. E. L. Ahrons.

P.S.—In looking through Vol. 51 of The Engineer I see that Hawthorn's engine, Comet, was illustrated on page 193.

CHARGES FOR ELECTRICITY.

Sir,—In your issue of The Engineer of November 18th, 1921, on page 546, in the middle column, you have a note of the meeting of the Institution of Electrical Engineers, which meeting, I notice, was devoted to a discussion of "How Best to Speed Up Electrical Progress."

I have just recently had my attention called to a little matter, which is perhaps worth noticing. At the moment I am without a house, and have been obliged to get such accommodation as has been available. For two months this summer I was able to hire a little flat in a town not 30 miles from Manchester. This flat was fitted with electric light, which we used as required. I was somewhat surprised at the end of my term to get two accounts for the current so used. The first account records that I used five units of electricity at 10d. per unit, for which I paid 4s. 2d. On the charge of 10d. per unit I have no kick to make, but what I do object to is to have an account rendered at the same time for a special reading of the meter, for which I am charged 4s. It seems to me that this is a matter which, although small, should not be passed over. In these hard times it is difficult to imagine that any corporation could render such an account.

It is also interesting to note that the same corporation rendered me an account for gas for cooking which came to £1 15s. 6d. and for which the meter was read twice, the same as for the supply of electricity, but the gas department did not make any charge for the extra reading.

The accounts as mentioned are in my possession, and if they would be of any interest to the Institution of Electrical Engineers I shall be glad to post them on for their inspection. This is certainly one of the ways which will not make the consumption of electricity popular. I trust that you will be able to publish this communication. J. E. Livermore.

December 5th.

SPEED ORDERS ON RAILWAYS.

Sir,—Would any of your more enlightened readers explain the theory underlying "speed orders" on English railways? I have talked to several practical railway men on the subject and find that an exceeding haziness and lack of unanimity exists on the subject. I have in mind, not the permanent speed restrictions, with which at certain points every railway is blessed to greater or less extent, but the temporary restrictions, due to engineering works in progress, such as are advised from week to week in each company's weekly programme.

Take, for example, repairs—let us suppose, of a heavy nature—to an underline culvert. The probable restriction at this point would be 15 miles per hour for all trains, and the usual warning boards would be displayed on either side of the "obstruction." But why 15 miles an hour, or any other figure? Is the figure arrived at arbitrarily or on some sound scientific or engineering basis? And what is the primary object of the reduction in speed, when fixed? Surely, twofold: (1) the safety of trains passing over the culvert; (2) the safety of the men employed on the repairs?

But how far does such a speed restriction in the (hypothetical) case cited meet the desiderata? Beyond the fact that it is obviously easier to pull up a train going at 15 miles per hour than at 60 miles per hour, and in an emergency it might be necessary to pull up a train dead (on the right side of the obstruction), I am somewhat at a loss—and I find others are, too—to appraise the wisdom and foresight of the (engineering) powers-that-be at their proper value.

Does 15 miles per hour in such a case constitute a safe speed, where 30 miles per hour might, or would, spell danger, or at least recklessness? Or is it a question of structural strains? That is, does a procession of trains pounding over the culvert at 15 miles per hour—I think this figure has become rather the god of the engineering hierarchy, that is why I adopt it for illustration—constitute a strain very much less than the same tonnage passing over it at 30 or 40 miles per hour? By this I mean—and I write as a layman in engineering matters—is it known from practical tests in what ratio stress diminishes with speed?

These are my difficulties. May I commend them to the consideration of your readers in the hope that someone will take up his pen in reply? Indoctus.

November 30th.

"MODERN PORTLAND CEMENT MANUFACTURE."

Sir,—Under the above heading you publish an article in your issue of October 21st.

The claim made by your contributor, that agitating slurry by compressed air is worth the extra expense, does not coincide with the writer's experience. Your contributor does not say what capacity of storage mixers he was considering. For a storage capacity of chalk slurry equal to 2600 tons of Portland cement at 36 per cent. moisture, 60 horse-power will be required when agitated mechanically. If hard limestone slurry at 33 per cent. moisture, the same power would agitate the equivalent of 2000 tons of cement. If the same quantities of slurry are kept agitated by compressed air, not less than 120 horse-power will be required. The writer recently visited a works with an output of 3000 tons per week. At this works a quantity of hard limestone slurry equal to 4000 tons of Portland cement is kept in storage and agitated by compressed air. There is one 250 horse-power and one 300 horse-power compressor installed, one being a standby; both are fully loaded when at work. In these days of high-priced fuel mechanical mixing can easily hold its own.

The wet process has advantages peculiar to itself, but surely the claim that "there is an absolute certainty of maintaining a perfect mixture of the materials as they pass through the rotary kiln" is a little far-fetched. Over 80,000,000 barrels of Portland cement were produced by the dry process in the United States last year, and no manufacturer in that country would admit that any change in the "mix" takes place when the material is passing through the kiln. It is a well-known fact that the flue dust is lower in lime content than the raw mix; but this holds good with wet process flue dust also. The great advantage possessed by the wet process is the ease with which a uniform mixture is obtained and the certainty that after a reasonable period of mixing a sample will truly represent the bulk. A further advantage is the ease of transportation for long distances at low cost.

The question as to what fineness coal should be pulverised in order to obtain maximum economy is still a debatable one. In America, where upwards of four million tons of coal is pulverised yearly, no agreement has been reached. The statement has, however, been frequently made that the extra cost of grinding coal finer than 92 per cent. to 94 per cent. through a 100 by 100 mesh sieve is not warranted by results. On the other hand, extravagant claims are made from time to time as to the savings that can be effected by grinding to 99 per cent. fineness. Anyone with experience in grinding coal will know that the difference in fineness as stated above bears no relation to the extra cost of grinding same. It may be 15 per cent. or even 30 per cent., according to the quality of the coal and the kind of mills employed for grinding. This is a subject that might very well be submitted to a research committee, and the writer would suggest that an investigation as to the true economy or otherwise of different finenesses of pulverised coal when used as fuel could better be determined by an evaporative test on a steam boiler than on a rotary kiln with all its variables. P. C.

British Columbia, November 16th.

SECOND-HAND MACHINE TOOLS.

Sir,—Much discussion having taken place recently as to the low prices at which machine tools are being sold by the Disposal Board, and as to the severe competition which machine tool makers are suffering from this cause, it is perhaps as well to issue a word of warning as to the risks which buyers run when they purchase such second-hand machine tools.

Some few of the machine tools so offered may be new, or practically new, and if made to makers' specifications they are doubtless good value if bought at the right price. On the other hand, it must not be forgotten that many of these "nearly new" machine tools were not made to makers' specifications, but were modified in some way to suit the work for which they were required, and that such modifications frequently render them useless or in some way unsuitable for the purpose for which they are purchased.

Buyers are not always sufficiently acquainted with the makers' specifications and with the details of machine tools to be sure that they are buying the standard machine, and there have been many cases where machines have been purchased at sales in the belief that they were standard, the buyer only finding out after he has bought them, and to his cost, that they lacked important details or necessary features.

Many machines, particularly those supplied for shell work, have quite different equipments from those required for general work, and although offered as "complete with tools," the purchaser has found, after he has taken delivery of the machine, that the tools are special and quite useless to him, and that he has to incur considerable extra expenditure for suitable tools.

In other cases machines have been sold without important parts; turret lathes, for instance, having a simpler speed arrangement and fewer feeds than standard, or being short of a chasing saddle or main turret slide, and thus not in any degree as useful as the complete machine. The sale catalogues do not always disclose these shortages, which are left for the unfortunate buyer to discover.

Another matter regarding which the buyer should beware is the condition of second-hand machines, not only externally, but internally. Many machine tools used for war purposes were greatly strained and damaged in use and suffered from severe wear in many of the parts, evidences of this strain, damage and wear not always being apparent externally. Alignments are frequently defective; bearings, gears, spindles, and other parts broken or badly worn; slides may no longer be straight and flat, and in a word the machine may be quite unsuitable for producing accurate work without a great deal of money being expended upon it, and, as is well known, to put new cloth into old garments is not considered prudent policy.

Cases are not uncommon in which a machine has been bought second-hand at a low price, and the purchaser has afterwards come to the maker with a doleful face to ask him to put the machine into workable condition, as in its condition as purchased it was quite unsuitable for his purpose. Machine tool makers have done a great deal of work in re-conditioning machines of this class, and in the end the machines have doubtless been rendered moderately efficient; but it is a question whether, even in these cases, the bargain has been a good one, as the cost of the additional work done upon them has been so high as to render the difference in cost between these re-conditioned second-hand machines and new machines very small.

Machine tool makers have, in certain instances, themselves bought machines at the sales of the Disposal Board and at other sales and have re-conditioned them at a moderate cost, thereby being enabled to offer them to the public at prices considerably less than the prices at which new machines can be sold; but in these cases the machine tool makers have been careful only to buy machines which could be re-conditioned by the expenditure of a small amount of work.

This is far from being the case with many of the machines purchased at such sales. It is an old maxim that "the best is cheapest," and the converse is almost equally true, that "the cheapest is by no means always the best," as many buyers have found out to their cost.

Another point which is worth the consideration of buyers is, that many of the machine tools offered at these low prices are not up-to-date, later and improved designs having superseded them, and it is well that the buyers, before placing their orders for such machines, should ask the original makers for particulars of the machines which they are now offering; otherwise they may be saddled not only with inefficient, but also out-of-date plant, inferior in productiveness to that which has been installed by their competitors. P. V. Vernon.

Coventry, November 30th.

FOUNDRY COSTS.

Sir,—The last three lines on page 604 of your current issue, in your notice of a typical discussion on "Foundry Costs," at a meeting of the Manchester Association of Engineers, do not in my opinion, convey a correct impression of the trend of the discussion. Your correspondent says, "There was, &c. &c., misleading." Looking over my own notes, I should say rather that "while some members objected to carrying the details of costing as far as suggested by Mr. A., there was a large amount of valuable information contributed by the various speakers that could not fail to be of benefit to those attending the meeting."

Daniel Adamson.

Hyde, Cheshire, December 5th.

[The passage runs as follows:—"There was a good deal of criticism of Mr. Adamson's suggested method of arriving at costs, which one speaker said were likely to prove very misleading."—Ed. The E.]

A QUESTION AT THE CIVILS' EXAMINATION.

Sir,—*Re* a correspondent's inquiry in your issue of the 2nd inst., I understand from the question that the second beams have the same load per foot run as the first beam, but are of half the span.

As demonstrated in most text-books, the bending moment diagram for a beam so loaded is a parabolic curve. In the second case the ordinates have the same ratio to the span as in the first case. Therefore the two diagrams for the second beams will each be precisely similar to that of the first beam, but not the same scale. F. Hovenden.

Mundesley-on-Sea, December 5th.

ELECTRIC RIVET HEATERS.

Sir,—We note in your issue of November 25th a letter from Mr. George Kenworthy with reference to electric rivet heaters. Mr. Kenworthy does not mention the danger of burning by coke and oil furnaces, which, we understand, is usually from 10 to 20 per cent. of the rivets put in the furnace, whereas the maximum allowance of spoilt rivets heated by the electric process is very slight, as even if the operator forgets to take out the rivets only three can be spoilt at a time, and he would not continue to do this. From experience we find that the rivets spoilt by this method number only from about 1 to 2 per cent.

Buckley, Saunders and Co., Limited.
P. Buckley,
London, December 6th. Technical Director.

Institution of Naval Architects Scholarships.—The following scholarships will be offered for competition in 1922 by the Institution of Naval Architects:—In naval architecture: The Elgar Scholarship, £130 per annum; the Cammell Laird Scholarship, £150 per annum; and the Armstrong Scholarship, £150 per annum. In marine engineering: The Parsons Scholarship, £150 per annum; and the John Brown Scholarship, £150 per annum. These scholarships are open to British apprentices or students, and are tenable—subject to the regulations governing each scholarship—for three years at the following educational establishments:—Glasgow University; Durham University (Armstrong College); Liverpool University; Royal Naval College, Greenwich; City and Guilds (Engineering) College, London. Full particulars may be obtained from the Secretary, Institution of Naval Architects, 5, Adelphi-terrace, London, W.C. 2.

A Seven-Day Journal.

Lord Inchcape on Public Affairs.

Owing to his pre-occupation in national affairs, more particularly his work on the National Economy Committee, Lord Inchcape did not, at the P. and O. meeting, make his usual comprehensive review of the shipping situation. His statement dealt rather with wider issues, the need of reducing taxation, and the necessity that the country generally should realise that there are no funds wherewith to finance fanciful schemes except those which are drawn from the pockets of the people. National solvency is, he rightly insisted, the goal at which to aim. The general conditions with which the country is faced were illustrated in the brief statement on the position of the great shipping company of which he is chairman. It has had a bad year, many of its ships either having been laid up or having left home ports with ballast cargoes, while mail and passenger services have been run at a loss. The new ships which the company has been compelled to order to restore the efficiency of the company's fleet have cost large sums to build and have had to be paid for by selling War Loan investments at a loss. The burden of operating expenses is still a heavy one, and the costs of handling cargo in home ports excessive, being in a typical case three times that which is paid in continental ports. Yet in spite of these handicaps Lord Inchcape is still optimist enough to believe that if reason would only guide both employers and employed we should emerge from the sea of troubles which threatens to engulf us.

British Industries Fair.

In a statement made yesterday, Sir Philip Lloyd Greame dealt with various aspects of the forthcoming British Industries Fair. The chief feature of interest was the explanation given of the Government export credit scheme, which should have a material effect on the business to be transacted with foreign buyers. Copies of a memorandum in which the scheme is discussed are being widely circulated, and it has been decided to have a branch of the Exports Credit Department at the Fair. A genuine attempt is being made by the Department of Overseas Trade to attract buyers. About 50,000 invitations will be issued to foreign buyers, and 250,000 to home firms. Explanatory pamphlets in nine languages are already being sent abroad in large numbers. It is clear, too, that the Fair itself will be larger and more representative than in previous years, and will be an adequate illustration of British manufacturing activities.

American Shipbuilding.

There is a general belief in this country that the American shipbuilding industry is a decaying one, and that British shipbuilders need not entertain any fears on the subject of competition by United States yards. It is true, of course, that the activities of American shipbuilders have been considerably restricted during the past two years and that the total output of the United States is very small in comparison with ambitions which were entertained in the period immediately following the Armistice. At the same time it is well to remember that the best of the American shipyards remain, and are likely to remain, in operation and to record large outputs. The Bethlehem Corporation returns which have been announced are a case in point. The output for the current year to date is given as 366,500 gross tons and includes twenty-four tankers, twenty warships, nine cargo vessels, and five liners. This record is, it need hardly be said, far ahead of anything which the largest British yard could achieve even when in full work.

The Submarine in Warfare.

It seems unlikely that the stand which is to be made by Great Britain against the retention of the submarine as an instrument of war will convince other Powers of the strength of the case against the assassin of the seas. There is not only the attitude of the United States to be considered, but that of the other Powers. When the French Naval Estimates came up for discussion in the Chamber last Monday Admiral Guépratte laid stress on the importance to France of a submarine and aerial fleet. At a later stage in the debate it was asserted that France, like Italy, will affirm the necessity for keeping herself in the second naval rank in the world.

Beardmore Profits.

The issue by William Beardmore and Co., Limited, of accounts for five years bring the financial record of this undertaking down to the end of the year 1920. The delay in issuing the figures has arisen mainly from the difficulty of agreeing with the authorities on the amount of taxation due from the company, and even now there are still some questions outstanding. It has not been found possible to present separate accounts for each of the five years, but the aggregate profits are given as £2,411,021, so that the average is not far short of the round half million a year. Ordinary shareholders in the company will be disappointed at the decision to pay them no dividend for the years 1919 and 1920. The money is available for a distribution on the ordinary shares, but the management have deemed it a wiser policy to provide against the continuance of depressed trading conditions. The placing of a million to general reserve and the retention of over £700,000 to carry forward to the credit of 1921 should certainly suffice to safeguard the immediate future of the company.

An Appeal for Cheaper Coal.

In asking miners to assist in bringing about a trade revival by the temporary adoption of an eight in place of a seven-hour working day, Sir Charles Macara is suggesting the simplest method of reducing the price of industrial coal. So long as miners insist on working fewer hours than other trades, coal must remain scarce and dear. Sir Charles believes that signs of trade improvement are apparent, and that both the home and foreign demand for British manufactures will revive if costs of production can be reduced. Cheaper coal is one step towards that end, and the miner has been told how he can assist without any further sacrifice of wages. That a little extra effort would be to his own advantage in the long run is not open to doubt.

Hydro-electric Power at Bradford.

Although the hydro-electric plant which has been put in operation this week by the Bradford Corporation is only a small-scale installation, subsidiary to a waterworks extension scheme, it gives practical demonstration of the advantages of utilising water power. It has been designed to supply electric power for the operation of the ropeways, crushers, cranes and other machinery equipment required for the construction of the dam at Scar House, and also for the lighting of the village and staff residences. Water is led from the existing Angram Dam into a steel pipe line connecting it with the power house on the banks of the river Nidd, one mile distant below the dam. The water thence flows through the turbines, and is returned to the river at a point immediately above the intake to the tunnel which supplies Bradford. Three sub-stations have been provided. The waterworks engineer to the Corporation—Mr. Lewis Mitchell—to whose initiative the works are due, may be congratulated on what has been achieved, and the hydro-electric staff of Vickers Limited, who were the sole contractors, on the way in which it has been carried out.

Pioneers of Flight.

Statements from authoritative sources, which are published in the current issue of the *Journal* of the Royal Aeronautical Society, appear to disprove the claims which had been somewhat freely conceded hitherto that the Langley aeroplane was the first man-carrying flying machine. Mr. Griffith Brewer is responsible for the statement, made, it should be noted, after two visits of investigation to the United States, that the Langley machine in the form in which it existed in 1903 was incapable of free flight. The 1914 Langley machine, which has been placed in the United States National Museum, with an inscription that it was the first man-carrying aeroplane in the world capable of free flight, was not, it is asserted, the 1903 machine resuscitated, but one into which structural changes had been introduced. Dr. Walcott, of the Smithsonian Institution, regards the later as an inferior machine. Mr. Griffith Brewer believes that on the evidence he has collected, including that of the pilot of the 1903 Langley machine, it can be fairly claimed that the credit of having invented and piloted the first aeroplane capable of sustained free flight belongs to Wilbur and Orville Wright.

Simplon Tunnel Completed.

By the completion of the roofing of the Simplon tunnel on Sunday last a work which has been in progress for twenty years has been crowned with success. The driving of both tunnels was put in hand concurrently, but only one was opened out to the full dimensions, the second having been used to assist the ventilation of the workings. The enlargement of the second tunnel has been in hand since the year 1912, and has not been attended by the difficulties which were encountered in the first tunnel work, during which underground springs were tapped and had to be diverted, and unexpectedly high rock pressures provided for, which delayed progress and made the tunnelling operations much more costly than had been anticipated. The stated cost of the first tunnel was £3,500,000 including, however, the driving of the heading for the other, and of the second £1,350,000. The length of each is about 12½ miles, over 7 miles of which is in Italian territory. It is intended to use the new tunnel for the train services, and to close the older to traffic so that some necessary repair work may be carried out. With the completion of the roofing on Sunday last, Swiss and Italian representatives united in laying a wreath on the memorial stone at Iselle to those who, through accidents, lost their lives during the tunnelling operations.

Profits of Steel Makers.

The report of Dorman, Long and Co. probably reflects a general condition of affairs in the steel trade. Profits, as compared with the previous year, have declined in round figures by a sum of £330,000. Such a result cannot have caused any surprise to shareholders who have kept in touch with industrial conditions during the period to the end of September last covered by the report of this company. With such a drastic cut in profits a reduction in the dividend could not be averted, but the decision to pay only 5 per cent., compared with 10 per cent. last year and 12 per cent. for 1919, has caused a good deal of disappointment, as the percentage reduction in dividend is appreciably greater than the percentage fall in profits. The net earnings of the company are now back to the level of the year 1917, but are still slightly in excess of those for the early period of the war.

Wages of Ironworkers.

It is good news that, as indicated by the accountants' investigation for wages purposes of the manufactured iron trades of the North of England, there has been a steady recovery from the slump in the early part of the summer. It is the fact, however, that for September and October of this year there was a slight reduction in output as compared with the two previous months. Wages have been falling under the sliding scale arrangement and have been reduced altogether by 137½ per cent. in 1921, after being increased by nearly that figure during the years 1919 and 1920. In spite of the heavy cut indicated by the figures quoted, ironworkers' wages are still 87½ per cent. above the base rate.

Forthcoming Air Conference.

The success which attended the first Air Conference which was held in London last year has led to the decision to hold a second Conference at the Guildhall in February next, under the auspices of the Air Ministry. At the last Conference service questions occupied a good deal of attention, but it has been decided that the February gathering will be concerned mainly with the development of commercial aerial transport. All aspects of this question will be discussed, and it is an advantage that Lord Weir has agreed to preside over the technical sessions. Invitations to the Conference are being issued to all those interested in the development of air transport, and arrangements are being made for demonstrations by aircraft and for a visit to the Croydon aerodrome for an inspection of as many types of machines as can be got together for exhibition purposes.

New London Telephone Exchanges.

Although the introduction of automatic telephone working on a large scale in London has been temporarily deferred, new exchanges equipped with most modern type of central battery plant are being gradually added. The latest of the new exchanges is that at Clerkenwell, which is the largest in London, being designed for more than 7000 subscribers' lines. The next new exchange will be that at Bishopsgate, where for the time being a temporary exchange is in operation pending the completion of the new building. It is understood that the relief given to the trunk exchange in London by the opening of the Toll exchange to give communication to a large number of towns within 20 and 30 miles of London has had the effect of greatly improving the long-distance trunk service. Calls to distant towns are now possible without the long and inevitable delays which formerly prevailed.

Relief Work on Harbours.

Among the plans for relief work which are dealt with in the report of the Development Commissioners, which has just been issued, special reference is made to schemes of drainage, land reclamation, and harbour improvements. The opinion is expressed that a number of such schemes, the merits of which are fairly well agreed upon, could be carried out with the aid of advances from the Development Fund. It is hoped that these recommendations will bear fruit, and that some of the schemes which have received the approval of local authorities, but on which the want of funds has prevented work being started, may be put in hand in the near future.

The Smithfield Club Show.

THE Cattle Show of the Smithfield Club, which was opened in the Royal Agricultural Hall, Islington, on Monday last, and closes to-day, is hardly to be distinguished from its predecessors, from an engineering point of view, except, perhaps, by an even more marked tendency than ever for the internal combustion engine to supplant the steam engine for the smaller units. It is also noteworthy that while all the familiar British firms are represented by exhibits, only two or three foreign manufacturers have stands, and among these one of the most prominent is a Dutch firm, which is showing a small threshing machine.

The heavier class of machinery is, as might be expected, represented by such firms as Aveling and Porter, Chas Burrell, John Fowler, Richard Garrett, Marshalls, Rustons, Wm. Foster and Wallis and Steevens, but there is so little variation in the engines shown from those which have been exhibited by the same makers within recent times that there is no need to describe them in detail here, yet it should be mentioned that on the stand of Richard Garrett and Sons there is a new type of threshing machine which has been designed to work in conjunction with one of the small tractors which are so largely used on more modest estates in the place of a full-sized traction engine. The threshing machine has been made very compact, the elevator, for instance, being brought inside the main framing, so that it can be hauled through a narrow gate, and, by employing ball bearings wherever possible, the power required by the machine has been reduced to a minimum. Otherwise the arrangement of the thresher is similar to its larger prototype.

One of the few steam engines which shows signs of novelty is the portable exhibited by Robey and Co., of Lincoln, of which we give an illustration in Fig. 7. Its peculiarity lies in the fact that the engine is totally enclosed, and consequently can be run at a fairly high speed without splashing oil about, with the result that the overall dimensions of the engine can be reduced very considerably. The extent of this reduction can be gathered by comparing the relative lengths of the engine and boiler with those of the orthodox open type engine. Another feature which has assisted in reducing the dimensions, specially those taken transversely, is the use of ball bearings for the crank shaft, &c. The engine exhibited is nominally of 10 horse-power, and has a cylinder 9½in. in diameter by 12in. stroke. It runs at 165 revolutions per minute, and with a boiler pressure of about 150 lb. per square inch will develop from 31 to 40 brake horse-power. The slide valve is of the piston type. The crank case, it will be seen, is in one casting with the crosshead guides and forms an oil well from which the lubrication of the running parts is effected on the splash principle. A large door on the top provides easy access to the big end, while the side of the case on the side next to the fly-wheel is formed by a cover large enough to pass the crank, together with its balance weight. At the cylinder end of the trunk there is a bulkhead which separates the guides from the piston-rod stuffing-box, so that the gland is quite accessible while the engine is running. The principle of enclosing the working parts has been extended even to the force pump, which is housed in the casing seen on the off side of the crank chamber. In fact, the engine is so well covered in that it is one of the makers' claims that it is specially suited for working in dusty or gritty surroundings. The boiler is of normal design, but has an extra large fire-box for burning inferior fuels when on colonial service.

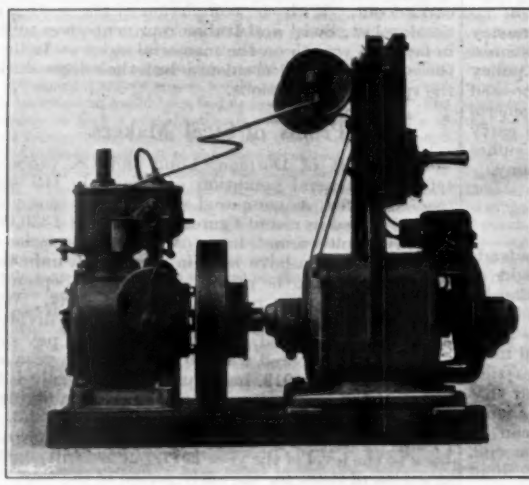


FIG. 1—BROTHERHOOD LIGHTING SET

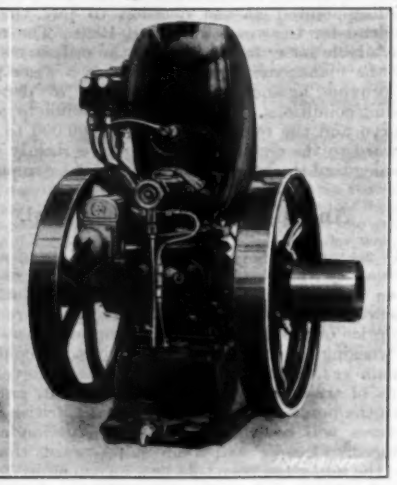
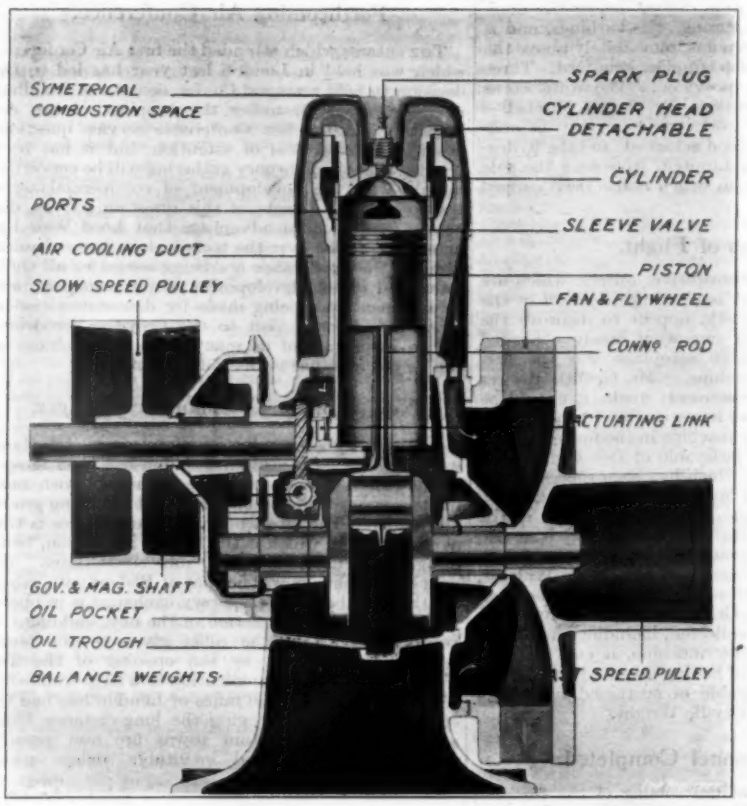
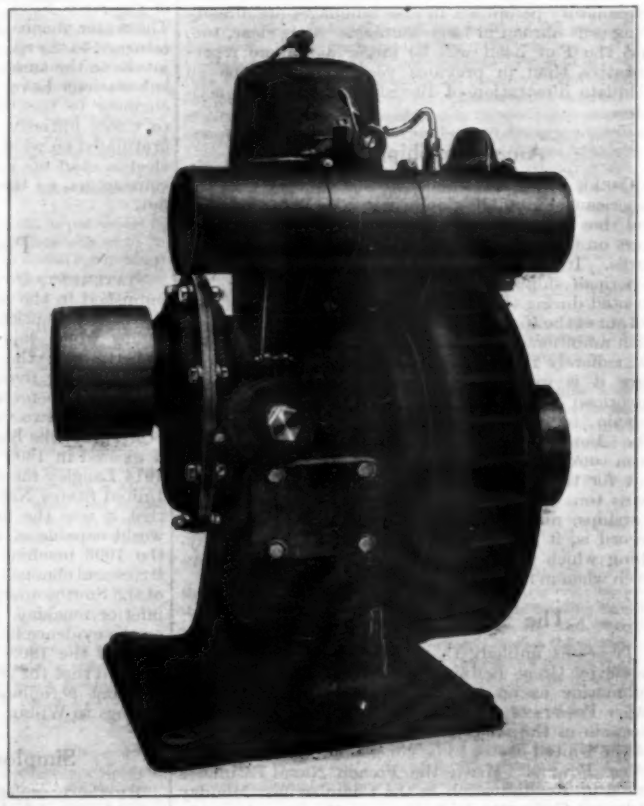


FIG. 2—PETTER'S PARAFFIN ENGINE

As we have already said, there is quite a large variety of small internal combustion engines at the Show, and it is a rather striking fact that while some of the makers urge, as a merit of their engines, that they will work on paraffin alone, others claim that it is better in the long run to use petrol as fuel. Among the latter class there is Peter Brotherhood, of Peterborough. On the stand of that firm there is a little electric lighting set, driven by a 2 brake horse-power petrol engine, of which we give an illustration in Fig. 1. The engine has a cylinder 2¾in. in diameter by 3in. stroke, and runs at from 1250 to 1300 revolutions per minute. The crank is of the disc type, and is overhung on its shaft, which runs in two ball bearings. The big end has roller bearings, and lubricates the engine on the splash principle. A noteworthy feature of the engine is the effective manner in which the water jacket is extended to cool the valve pockets and the exhaust. The engine is connected with a 1-kilowatt dynamo by means of a flexible coupling, while a little switchboard is mounted above the dynamo. There are a few turns of series winding on the field coils, so that the dynamo can be used as a motor in starting the engine, and arrangements are made on the board for preventing the storage cells, with which the engine works, from being overcharged or run down too far. The whole set is very compact, and looks as if it should stand up to its work for long periods.

The little paraffin engine shown in Fig. 2, which is being shown by Petters Limited, of Yeovil, is one of the class in which the makers have decided to take advantage of the comparative cheapness of paraffin, as a fuel, but use a spoonful of petrol for starting up. The petrol is poured into the vaporiser, and the engine started. As soon as the engine begins to move a diaphragm pump starts to supply paraffin to the vaporiser, and by the time all the petrol is used up the engine is sufficiently warm to go on working on the paraffin. The engine shown, which is known as the Petter Junior, is of 1½ brake horse-power, and has the water jacket arranged in the form of a hopper round the cylinder, so that no water-circulating pump is required. The hopper is so constructed that a water tank can be easily added if the engine is required to run for long periods without stopping. A new system of lubrication has been adopted on this engine, and works quite automatically. There is a reservoir for the oil, which is kept under a slight air pressure by a pipe connection with the crank chamber. The air pressure forces the oil, through two sight feeds, to the two main bearings, and thence, by way of holes drilled in the crank shaft, to the big-end bearing. The gudgeon pin and the cylinder walls are lubricated by splashing from the crank case. The engine is, of





FIGS. 3 AND 4—WALLACE'S SLEEVE-VALVE ENGINE

course, of the two-stroke type, and has magneto ignition. The makers inform us that they hope to be able to produce a little electric lighting set, embodying this engine, which, together with a storage battery and all the necessary accessories, will cost only about £100. There are on this stand several other Petter engines, but their features are too well known for it to be necessary to describe them here.

Another small engine of novel design is being exhibited by Wallace (Glasgow), Limited, of Dennistoun, Glasgow, and is shown in Figs. 3 and 4. Its two outstanding features are the use of a sleeve valve, and air cooling in the place of a water jacket. The sleeve valve is of the type which has a semi-rotary movement besides its vertical reciprocation, and is driven by a link off a crank on the half-time shaft, as can be seen in the section. The half-time gear wheels are of generous size, and the shaft is extended to carry a driving pulley, which naturally works at half the speed of the pulley on the crank shaft. The air cooling is effected by covering the cylinder with a sheet metal cowl and drawing the air through by the fanning action of the fly-wheel, which, for this purpose, is cast hollow and has vanes round the periphery. The makers claim that the carburetter fitted on this engine will work with either petrol or paraffin without adjustment.

Another scheme for providing economically small amounts of power is carried out in the new small suction gas producer exhibited by Crossley Bros., Limited, of Openshaw. This producer has been specially designed for supplying gas to engines of about 6 horse-power, and its construction has been simplified in every possible manner. To this end the usual vaporiser for providing steam to the fire has been discarded, and the water is allowed to trickle directly on to the hearth, which is of the Crossley open-stepped type. Four little drip cups are arranged round the outside of the hearth, and the water is supplied to them through regulating cocks. Grooves in the hearth lead the water from the drip cups. The scrubber and filter are in one casing, with the filter at the bottom. The scrubber is filled with coke, while the filter is packed with wood fibre. The capacity of these producers is such that they only require recharging every three or four hours, according to the load which is being carried.

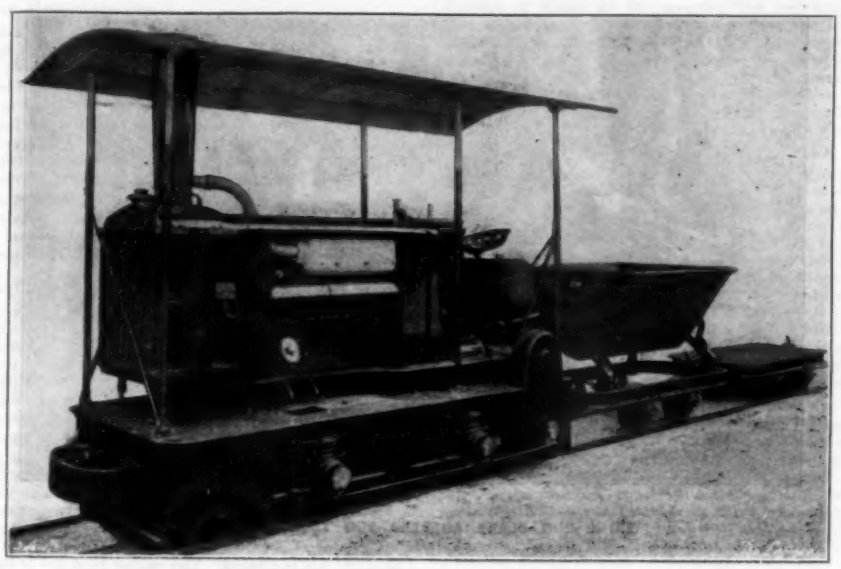


FIG. 5—BLACKSTONE'S OIL LOCOMOTIVE

On the stand of Marshall, Sons and Co., Gainsborough, there are examples of the steam tractor, portable engines and oil engines which we have recently described, and a new machine in the form of a flax puller. This machine has been tried in bringing in the last harvest, and is said to have worked very satisfactorily. The pulling of the growing flax without injury to the fibre is effected by a succession of rotary steel combs carried on two endless metallic chains, which travel on mild steel rollers. These rollers, in turn, run on steel angle rails fixed on each side of the puller. At the back end of the puller the rails are curved to serve as stationary cams. The divergence given to the comb mechanism in travelling along the cams produces a lifting or backward movement and thus brings the comb cleaners into action. In this way the combs are kept clean, and pulled flax is not carried over the upper structure of the machine. The combs come in contact with the crop on the underside of the machine, and as the machine is drawn forward, either by horses or a tractor, the combs travel backwards on the underside. This contra-action reduces any risk of de-seeding which might possibly occur with an over-ripe crop. The action of the machine is described as being so perfect that practically all weeds are left standing in the soil.

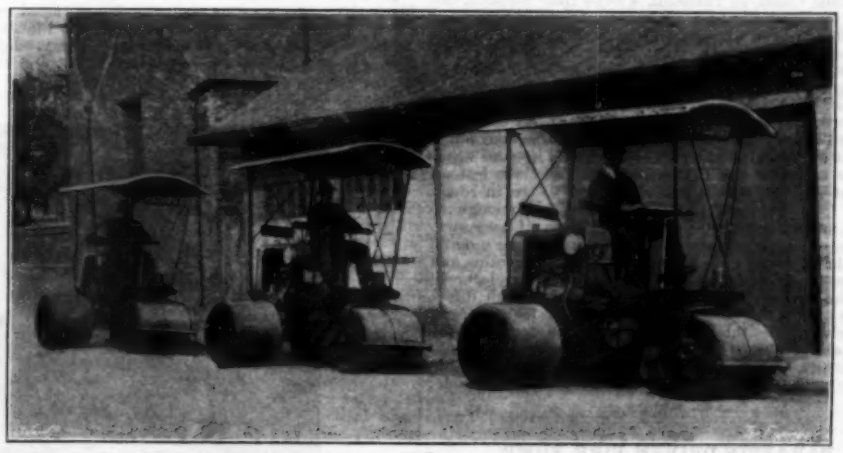


FIG. 6—BARFORD AND PERKINS MOTOR ROLLERS

A motor roller, three of which are shown in Fig. 6, that has been made specially light for such services as rolling cricket grounds and footpaths, is being exhibited by Barford and Perkins, Limited, of Peterborough. It is intended to roll in widths of 5ft. or 6ft., according to the width of the back rollers, and the total weight can be brought down to 1 ton 5 cwt. The standard weight for 6ft. width is, however, 1 ton 15 cwt. The back rollers are made of boiler plate, and can be filled with about 5 cwt. of water ballast. The front roller, of cast iron, is divided to facilitate steering, but is not arranged to take water ballast. There is a coiled spring in the top of the steering head to make the machine ride more easily, and the steering gear is of the plain, direct, chain and sprocket type. In running order the weight is nearly equally divided between the three rollers. The engine is a Coventry Simplex four-cylinder set of 12 horse-power, and drives through worm and toothed gear on to a transverse countershaft. The final drive is by means of a roller chain. No differential gear is fitted. The ordinary rolling speed is 4 miles per hour. A detail, but nevertheless useful feature, about the machine is the dishing of the back rollers so that the axle does not extend beyond the rim and thus allows the roller to be worked right up alongside a vertical wall.

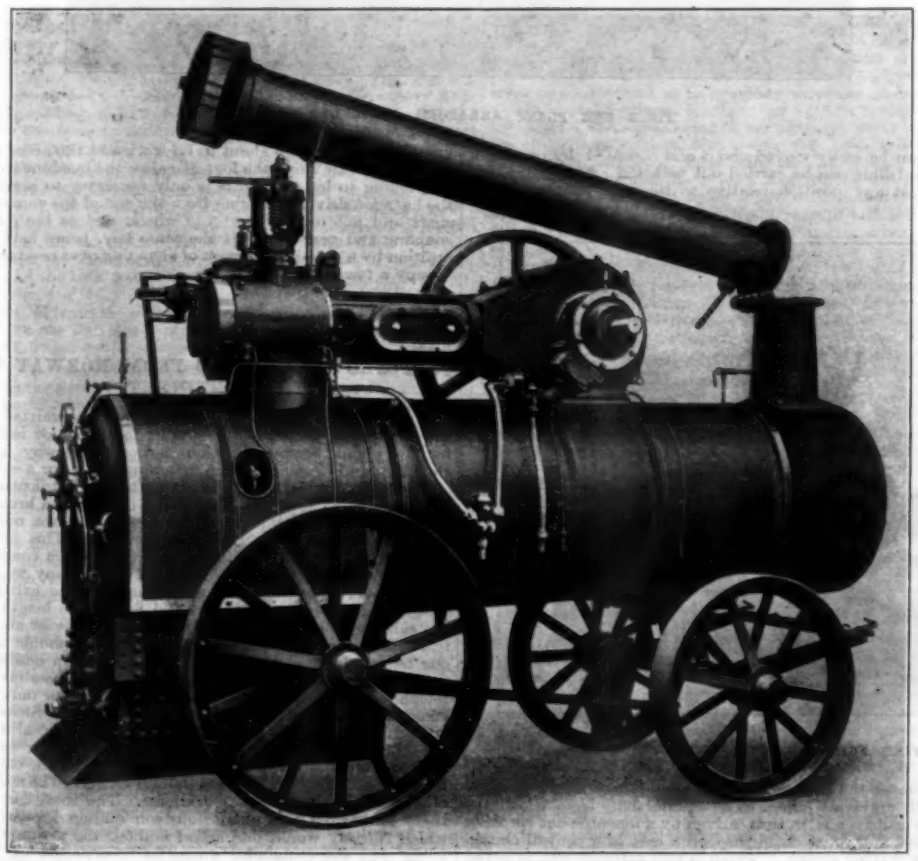


FIG. 7—ROBEY'S NEW PORTABLE STEAM ENGINE

A very neat oil-driven locomotive, of which we give a half-tone engraving in Fig. 5, is being exhibited by Blackstone and Co., Limited, of Stamford. It is substantially built, and in many respects follows the lines of steam locomotive practice. Thus the driving wheels are coupled by means of rods instead of chains, which do not always work satisfactorily for this purpose on account of the difficulty in adjusting the shafts to take up the stretch of the chain and in keeping them exactly square at the same time. The main frames, horn-plates and axle-boxes also are reminiscent of steam-engine practice. The engine is of 25 brake horse-power, and has three cylinders 5in. in bore by 6½in. stroke. The normal speed is 750 revolutions per minute. The engine starts instantly from cold on paraffin, no petrol or lamps being used, and is fitted

with an adjustable governor, which can be regulated by the driver to the desired speed of travel. A self-starter enables the engine to be started in any position and under all conditions, the design rendering it unnecessary for the engine to run idle at any time, as, after the initial starting operation, it can be stopped and re-started at will by merely depressing a lever. The gear-box forms the rear part of the engine frame, and is bolted to the engine base, so that it must keep in alignment. The whole unit—engine and gear-box—is mounted in the main frame with three points of attachment, two at the back and one in front, so that racking of the main frame will not distort the engine. From the gear-box the power is transmitted to a cross shaft on a level with the main axles, by means of chains running in oil. Coupling rods connect this shaft with outside cranks on the driving wheel axles. The following are the leading dimensions of the engine :—

Length over buffers	10ft. 3in.
Length over frame	8ft. 4in.
Height over chimney from top of rail	7ft. 7in.
Gauge	24in.
Wheel base	3ft. 3in.
Overall width	4ft. 8in.
Weight, ordinary	3 tons
Pull exerted before revolving wheels on dry rails	1200 lb.
Speeds, three in either direction	3.75, 5.6 and 7.5 m.p.h.

The engine can be driven safely round a curve of 20ft. radius, and although it ordinarily weighs 3 tons, the framing, &c., are sufficiently strong for it to be loaded up to 4 tons if greater adhesion is required.

DEEP-WATER HARBOUR ON THE GOLD COAST.

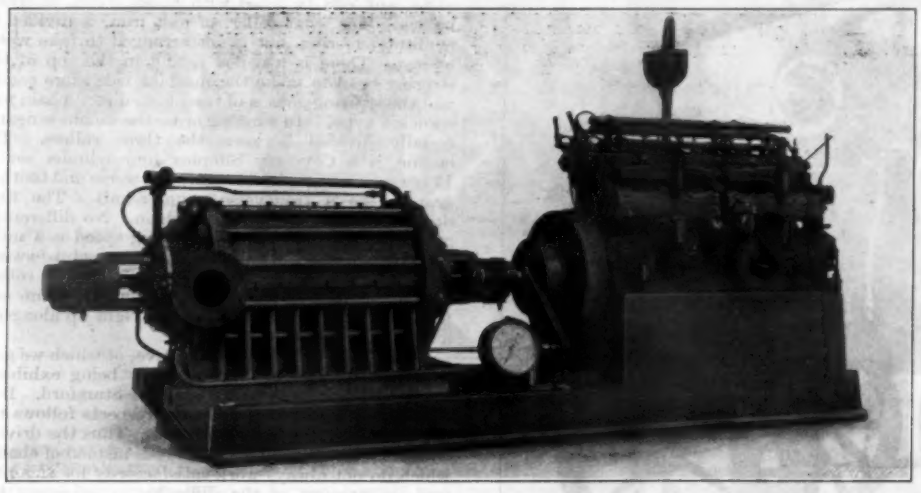
A COMMENCEMENT is just about to be made with the construction of a new deep-water harbour, the only one in the Gold Coast, at Takoradi, 4 miles from Secondi, the scheme for which has been approved. At present as much as 600,000 tons of exports and imports have to be conveyed to or from ships, a ton at a time, in surf boats with eleven men, a system which results in considerable damage to the goods, delay, demurrage, &c. The first portion of the work which is now about to be begun will cost £1,600,000, and take three and a-half years to complete. The Gold Coast will then, it is said, have a harbour much like that of Colombo, in which ships can lie in calm water within a couple of hundred yards of the wharves instead of, as at present, a mile and a-half out to sea in rough water. The projected harbour will be large enough to contain twenty to thirty ships, and later on, if necessary, wharves will be constructed so that ships can be moored alongside and cargoes discharged straight into trains and warehouses. It is estimated that the present project will halve the cost of lighterage and result in enough direct revenue to run the harbour and to pay the loan charges. The work includes the building of a breakwater along the reef of about 7500ft. in length, and of a second breakwater 4000ft. long. A model and up-to-date port township will also be constructed, for which ample land is available.

PARAFFIN-DRIVEN FIRE PUMP.

THE pumping engine shown in the accompanying illustration is one of several which have recently been supplied to the Air Ministry by the Parsons Motor Company, Limited, of Southampton, and is to be used for increasing the usual water pressure for fire extinguishing purposes in cases of emergency.

The plant comprises a 42 horse-power six-cylinder paraffin engine of the makers' standard design, which runs at a speed of 950 revolutions per minute, and is started up on petrol. The engine is directly coupled with a nine-stage turbine centrifugal pump, by the Pulsometer Company, of Reading, capable of delivering 200 gallons of water per minute against a head of 310ft.

The engine is fitted with a Parsons vertical high-speed



PARAFFIN-DRIVEN FIRE PUMP

enclosed governor, capable of effectively controlling the plant, and in the ordinary way taking charge of the set within a very wide range of loads; but in order to avoid the possibility of any mishap, having regard to the purpose for which the plant is intended, the pump is provided with a special device to prevent overloading of the engine in the event of the bursting of one of the fire mains.

PORTABLE TREE-FELLING AND LOG SAW PLANT

W. RICHARDS AND SON, LEICESTER, ENGINEERS

FIG. 1—THE PLANT ADAPTED FOR FELLING TREES

PORTABLE TREE-FELLING AND LOG SAW PLANT.

A HANDY self-contained tree-felling and log-sawing plant, driven by a petrol engine, is being placed upon the market by Messrs. W. Richards and Son, Phœnix Iron-works, Leicester. Fig. 1 shows the plant adapted to felling trees, and Fig. 2 shows it arranged as a log saw. It can be easily moved about and operated by one man. Tree felling can be carried out with the engine placed in almost any position relative to the tree, as the engine operates the saw through the medium of a coupling-rod with universal joints. The countershaft from which the saw is driven is, in turn, driven by a machine-cut sprocket wheel and roller chain through a cast iron conical clutch. The driving sprocket, which is also machine cut, is keyed to the engine crank shaft. The object of the clutch is to obviate the stopping and restarting of the engine every time the cut is altered. The engine is of the hopper type, developing 2½ horse-power, with magneto ignition, water-cooled valve chamber and ring-oiled bearings. It is provided with a pulley, so that it can also be used for driving stationary machinery. When used for sawing logs—as shown in Fig. 2—the handles of the machine rest on the log, when cross-cutting, a movable chain and pointed hook being provided to hold the log secure. The travelling wheels can be put into two positions, one for wheeling the machine about to its work and the other for moving the saw along the log. To alter the machine from tree felling to log sawing, it is only necessary to remove the hexagon driving coupling from the end of the countershaft and put on the saw gear wheel, and as both the coupling and gear wheel fit the same key, being held in position by a set pin, the work of changing over need only occupy a few minutes' time.

FIG. 2—THE PLANT ARRANGED AS A LOG SAW

PROPOSED NEW CABLES FROM NORWAY TO THE CONTINENT.

IT is reported that proposals have been submitted to the Norwegian Board of Telegraphs for two new cables for telephonic communication between Norway and Denmark and Germany. The first proposal is for a cable either from Arendal to Hirtshals or from Fredriksvaern to Hirtshals, to cost about one and a-half million kroner. The length of the cable would be 77½ or 88½ sea miles, according to the connecting points chosen. This cable would give three telephonic and one telegraphic connections. The cable between Arendal and Germany would be laid over practically the same route as the existing telegraph line between Arendal and Sylt. The length of the cable would be 440 kiloms., and the total cost about five million kroner. On this cable three telephonic and one telegraphic connections could be made. In addition to the connection with Germany it would be possible to telephone to countries with which Germany is or may be connected, such as Holland, Belgium, France, Switzerland, Italy, &c. It is stated that a further proposal may be submitted to the Board of Telegraphs for a cable between West Norway (Stavanger) and England, calculated to cost about six to seven million kroner. The length of cable would be about 500 kiloms. The total cost of these lines would be about fourteen million kroner, of which Norway would find seven million, the assumption being that the remainder would be contributed by the other countries in the same manner as in the case of the existing telegraph cables.

Railway Matters.

IT is reported from Capetown that the Government of South Africa has decided on the electrification of the Glencoe-Maritzburg line.

A MEETING of the Railway Rates Advisory Committee will be held in the Old Hall, Lincoln's Inn, on Tuesday next, the 13th instant, to consider the classification of returned empties.

IT is announced that Mr. Lightly S. Simpson has resigned his position as chief mechanical engineer at the Ministry of Transport, and sailed for Buenos Aires on the 25th ultimo to take up the appointment of chief mechanical engineer of the Cordoba Central.

THE English railways which form the constituent companies of the North-Western, Midland and West Scottish group are seeking parliamentary powers to provide and use road vehicles for the conveyance of passengers and goods. The companies in the West Scottish group are promoting a separate Bill for the same purpose.

THE closer association between some of the companies is reflected in the December train alterations. Better connections between the East Coast route and the Great Eastern Railway are being given at Peterborough; and through carriages now run between Halifax and Birmingham and Bristol and Halifax *viâ* the Lancashire and Yorkshire and Midland.

AN official Canadian Government publication has been issued containing the full official text of the Grand Trunk Award, and the reasons for the award. The awards, and reasons therefore, of the chairman, Sir Walter Cassels, and the two arbitrators, Sir Thomas White and Mr. W. H. Taft, are set out separately. The award is, of course, the subject of an appeal to the Privy Council.

THE constitution of the Railways Amalgamation Tribunal was laid down in Sec. 9 (2) of the Railways Act. It is to consist of Sir Henry Babington Smith, who is to be the chairman, Sir William Plender, and Mr. G. J. Talbot, K.C. The tribunal has now appointed Mr. H. A. H. Steward, the Light Railway Commissioner, to be its clerk. The offices will be at 1, Horse Guards-avenue.

WE were surprised to see in the daily Press recently an intimation that the charges for traders' tickets had been reduced; one paper, however, modified its statement the following day. Traders' tickets were advanced last year when season tickets were increased in price; but, as we recorded at the time, on page 209 of our issue of August 26th last, were reduced when Government control ceased.

THE directors of the North British Railway Company have issued a circular explaining that they cannot yet pay the dividends declared at the beginning of the year or any interim dividend for 1921, as the Government has made further deductions from their bills for the cost of repairing rolling stock. The amount in dispute has now reached £1,120,000. It is expected that a settlement or a judgment will be obtained early in the new year.

THE Midland Railway works at Derby, where about 10,000 men are employed, are to be closed for a full week at Christmas. Short time is already being worked, the average being four days a week. At the London and North-Western carriage works at Wolverton the situation is worse. About 5000 men are employed there, and the greater number work only three days a week and many are standing off for weeks at a time. These works ar eto be closed for ten days at Christmas.

A REDUCTION of 38.09 per cent. in the number of workmen's tickets issued during August, as compared with August, 1920, mainly accounted for the number of passenger journeys falling off by 21.03 per cent. The greater use of excursion fares, of which only a few were available in August, 1920, caused them to increase in number from 484,675 up to 5,634,943. The average receipt per passenger increased from 16.64d. to 19.98d. The falling off in traffic caused a reduction of 5.18 per cent. in the total passenger receipts, but train mileage increased 3.86 per cent.

THE general merchandise carried in August, 1921, was 17.91 per cent. less in tonnage and the ton-miles less by 19.72 per cent. than in August, 1920; the coal, coke and patent fuel 3.58 per cent. less in tonnage and 3.54 per cent. in ton-miles; other mineral traffic was 43.21 per cent. less in tonnage and 44.42 per cent. in ton-miles; and the total goods traffic was 15.28 per cent. less in tonnage and 16.86 per cent. in ton-miles. In oil there was an increase in tonnage of 30.82 per cent.; ironstone and iron ore decreased by 89.62 per cent.; iron and steel by 48.58 per cent.; and pig iron by 56.91 per cent.

THE cause of an accident on the North British Railway on September 21st was the same as that of the Chelford, London and North-Western Railway, disaster of December 22nd, 1894. Fortunately, the results were far less serious. A wagon was standing in a siding at Drem, and although the branch at that point has not a severe falling gradient, a gusty wind which was blowing from the west, *i.e.*, towards North Berwick, drove the wagon out of the siding and on to the single line, where a passenger train ran into it. The night was dark and overcast, with no moon. As Major Hall says in his report on the collision, "The case is of interest as showing how, in favourable conditions, such movement may be initiated and continued on gradients so comparatively flat as those in question."

THE question of the wages and hours of duty of the Scottish railwaymen came before the Central Wages Board on Monday last, and was adjourned until Tuesday next, the 13th. It will be remembered that we stated in this column on October 7th that the Associated Society of Locomotive Engineers and Firemen had accepted a reduction in pay on condition that the eight-hours' day was retained. The N.U.R. and the Railway Clerks' Association would not accept this arrangement. During the present adjournment the railway companies are to prepare statistics showing the grounds upon which they demand a change. Complaint has also been made that the councils referred to in Section 63 of the Railways Act have not been set up. The men suggest that the companies do not want them; the companies reply that they are busy with the grouping schemes.

Notes and Memoranda.

IN an investigation of the reduction of iron oxide, being conducted at the North Central experiment station of the Bureau of Mines at Minneapolis, the resistance to the passage of air through beds of ore was the first factor studied. The results indicate that the pressure drop required to force air through an ore bed is directly proportional to the flow, and that this pressure varies inversely as to the square of the size of the ore particles. Experiments are also being conducted to determine the rate of transfer of heat from an air stream to an ore bed through which the air is flowing.

TESTS of fuel tanks entered for the Air Ministry competition for safety tanks for aircraft commenced at the Royal Aircraft Establishment, Farnborough, on Monday, December 5th. The object of the competition, for which prizes amounting to £2000 are being offered, is to obtain a tank that will withstand the shock to which it may be subjected in an aeroplane crash without either bursting or leaking, and thus eliminate almost entirely the possibility of fire in such circumstances, and will also withstand the effects of enemy action by machine gun and shell fire. The competition, which was thrown open to all the world, has brought in twenty-six entries—nineteen from Britain, three from France, and one each from America, Belgium, Italy, and Japan.

WHEN it became apparent to the mine managers of the Transvaal goldfield that the dry jack hammer was to be prohibited, they were forced to find an efficient substitute. The axial water feed, or "wet" jack hammer, did not, apparently, find favour. With solid steel and water externally applied, it was found that there was a limit to the depth of hole which could be drilled below a certain angle, on account of the difficulty of sludging. In order to obtain a greater depth of hole, various schemes have been tried, amongst which the Simmer and Jack method has, according to the mine inspector's report, proved a success. The manager of the Simmer and Jack has converted all his dry jack hammer machines into solid steel throughout the mine. Ordinary ¾in. hammer steel is used, a slight flat is put on the steel for the last 12in., and a half turn put in about 8in. from the cutting edge; this twist acts as an impeller, the sludge being driven away from the cutting edge or drawn away, according to the direction of rotation. Machines of both directions of rotation are in use, and work satisfactorily.

THE manufacture of steel from iron ore by a direct process which would involve the use of atomised fuel oil or powdered coal has been described before the American Iron and Steel Institute by Mr. A. E. Bourcound, a New York engineer, who has been conducting exhaustive tests for some time. Mr. Bourcound declared the "direct process" had a "reasonable chance of industrial existence," and that, properly conducted, the work could be done at a price which would compare favourably with the cost of manufacturing steel under methods generally followed heretofore. His process differs from the blast-furnace method, in that the latter involves the use of reduction gases formed in the charge of coke in the furnace, while the former contemplates the use of reducing gases projected against the mass of ore contained in a furnace of special design. It was claimed that the "direct process" would open up great possibilities for the development of a steel industry in regions where blast-furnace operations are almost impossible because of the cost of supplying coal to plants. California iron ores could, for instance, be smelted in that state by the use of fuel oil, and the Pacific Coast could look forward to the building up of a local steel industry.

IN an exhaustive report presented to the Engineering Institute of Canada on the corrosion of cast iron water pipes in the Winnipeg district, Mr. Nelson Smith gives the following description of an experiment:—"Two cells were so constructed as to provide two pieces of cast iron not in contact with each other, but both in contact with moist soils, the anode being in contact with limey silt and the cathode in contact with a clay soil, both soils being kept moist. One of these cells had an initial E.M.F. of 2.1 millivolts and the other 9.2 millivolts, which latter became 7.6 millivolts when filled with distilled water. Within the first three hours No. 1 rose 10 millivolts and No. 2 rose 40 millivolts. In about three days No. 1 had reached 14 millivolts, and No. 2 63 millivolts, which were reduced respectively to 12 and to 48 millivolts after adding more water. The voltages varied for two months, alternately rising and falling. At the end of about two months, the cells having stood on open circuit, and without any addition of water, the polarity showed a reversal in both cells. Upon adding water once more, No. 1 recovered its original polarity and voltage, but No. 2 increased its negative polarity to 64 millivolts negative, while No. 1 went as high as 66 millivolts positive."

DURING the course of a lecture delivered before the students' section of the Institution of Electrical Engineers, Sir Philip Dawson made a comparison of the cost of equipping and working single-phase and direct-current railways. The figures given for the former were based on the experience of the London, Brighton and South Coast Railway, whilst the direct-current figures were derived from various lines, such as the Manchester-Bury line, which runs a service of trains similar to that of the Brighton Railway. The lowest cost of installing a low-tension direct-current system, including cables, sub-stations, bonding, signalling, &c., was shown to be about £10,000 per mile of single track, whereas the corresponding cost for the Brighton Railway extensions will only be about £6000. The cost per ton-mile of working steam trains for the Brighton Railway had been found to be as follows:—Local passenger trains, 50.51d., local goods, 108.083d.; through passenger, 41.769d.; and through goods, 66.054d. The corresponding figures for the single-phase electric trains being 27.58d., 64.084d., 26.741d., and 52.028d. Figures were given to show that the alternating equipment is not much heavier than direct-current equipment developing the same power. It was pointed out that although a low-tension direct-current system requires many more sub-stations than an alternating-current system, the increased expenditure is justifiable where the traffic is sufficiently dense to keep each sub-station operating at a good load factor.

Miscellanea.

THE Chilian Government has submitted to Congress a Bill providing for the allocation of 143,000,000 pesos to harbour improvement works and the extension of railways to the Argentine frontier.

A MOTOR car, which is said to compare favourably in quality of workmanship with European cars, has been produced by the Yangtze Machinery Works, China. The company intends to enter into competition for the native market.

A SCHEME has been sanctioned for widening the Brighton to London main road for a length of about 3 miles, commencing at Patcham Place and terminating about 200 yards on the London side of Pyecombe Post Office. The scheme came before a special meeting of the East Sussex County Council a day or two ago.

LECTURING before the members of the Birmingham Metallurgical Society recently on "Metal Corrosion," Mr. J. Newton Friend said iron did not rust in perfectly dry air. A piece of iron had been kept in dry air for about nine years, and it had been found there was no sign of rust. Iron did not rust in perfectly air-free water, and it was known that metal had been kept for several months in steam without the slightest trace of rust forming.

THE first number of the *Bulletin* of the Cleveland Technical Institute has recently been published, and contains a large number of abstracts of technical papers, articles and lectures. The abstracts are printed only on one side of the paper, so that they can be pasted up and filed for easy reference. The Cleveland Technical Institute is, of course, the Middlesbrough concern, originally conceived by Dr. J. E. Stead, which was opened in September last.

IT is announced by cable from Melbourne that the Commonwealth Arbitration Court has rejected the claim of the combined trades unions for a reduction in the standard working week throughout Australia from forty-eight to forty-four hours. The President of the Court declared that such a reduction would add greatly to the ranks of the unemployed, and would also be a serious blow to Australian industries, which would be unable successfully to compete with those of other countries.

IN electrical engineering circles, states the *British Chamber of Commerce Monthly Journal*, there is a strong belief that prospects for the future are bright. It is understood that numbers of electrical power schemes are under consideration on the Continent and in certain of the Dominions, while improvements to be undertaken in the United Kingdom telephone, &c., services, all give promise, at least, that the British electrical industry will have good opportunities of increased business.

OWING to the flatness of the town and the excellent road surfaces, Blackpool is generally regarded as an excellent centre from which to operate electric vehicles. It is claimed that in this town these vehicles give better results than in most other places, as, owing to the absence of hills, the most efficient service can be obtained from the cells. One Blackpool firm is using four electric vehicles fitted with Chloride batteries. One of these batteries has given 2½ years' service, and has been in use for over 9000 miles, with a minimum mileage of 20 a day.

EXCELLENT progress has been made with the construction of the Birmingham electric power station at Nechells, and the first section of the new installation will, it is hoped, be brought into production early in the new year. Recently members of the Electric Supply Committee, accompanied by the Lord Mayor, paid an official visit to inspect the progress of the work. The consulting engineer, Mr. C. P. Sparks, and the city electrical engineer, Mr. R. A. Chattock, with other officials, were in attendance. The buildings and plant were inspected, and general satisfaction was expressed at the progress made.

ACCORDING to the *South African Mining and Engineering Journal*, a prominent Rhodesian geologist, who recently has been investigating the mineral prospects of an extensive tract of country in Mozambique, has given it as his opinion that there are excellent indications of discovering oil near Inyaninga in that territory. This pronouncement has been arrived at after a most careful examination of the stratigraphical features and a correlation of strata with the oil-bearing rocks of Madagascar. It is proposed to commence boring operations in the near future, and for that purpose it is intended to employ machinery at present in use on the Beira-Zambesi Railway.

THE United States coastguard cutter Tampa, the first of four electrically driven cutters to be placed in service by the Treasury Department, was recently delivered to the authorities at the port of New York. The vessel, which was built by the Union Construction Company, Oakland, Cal., is 240ft. long, has a 39ft. beam, is 25ft. 6in. deep, and displaces 1600 tons at a mean draught of 14ft., and has a speed of 16 knots. The main propelling machinery consists of two Babcock and Wilcox water-tube boilers fitted for oil burning, which supply steam to a turbine-driven alternating-current generator, current from which operates a 2600 horse-power synchronous motor at a propeller speed of 130 revolutions per minute.

IT is reported from Stockholm that the Aktiebolaget Marinbetong has placed before the Swedish Railway Board a project for a reinforced concrete Baltic ferry steamer designed by the engineer, M. Eric Carlsson, formerly a constructor in the American Marine Department. The proposed dimensions of the vessel are:—Length, 135 m.; beam, 18.50 m.; draught fully loaded, 5.90 m.; and displacement, 7000 tons. The hull and bottom would be double, the intervening space being divided up into many water-tight compartments. The whole of the cargo, it is suggested, should be carried on the deck and car deck, which would be of reinforced concrete, the lower being at a height of only 2 m. above the water line. There would be also two upper decks of light iron and timber construction for the accommodation of 190 passengers. The car deck would have four tracks with a total length of 340 m., accommodating forty goods wagons. The engines would indicate up to 8500 horse-power, which, it is estimated, would give the vessel a speed of 18 knots. It is proposed to use Diesel engines. The new vessel would be placed on the projected Stockholm-Finland route.

(For description see page 611)

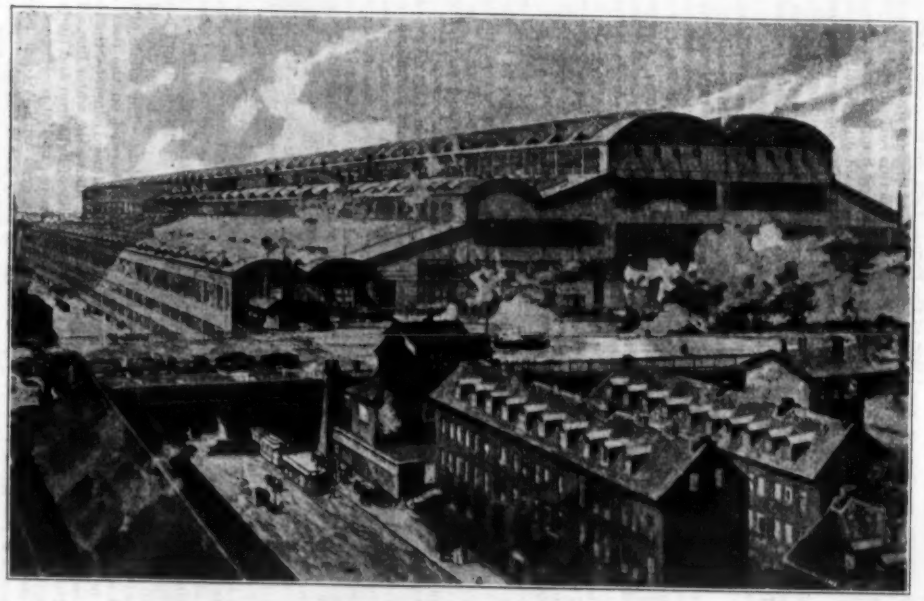


FIG. 5—NAVAL GUN MOUNTING SHOP—EXTERIOR

FIG. 6—NAVAL GUN MOUNTING SHOP—INTERIOR

FIG. 7—BIG NAVAL GUN SHOP, No. XI.

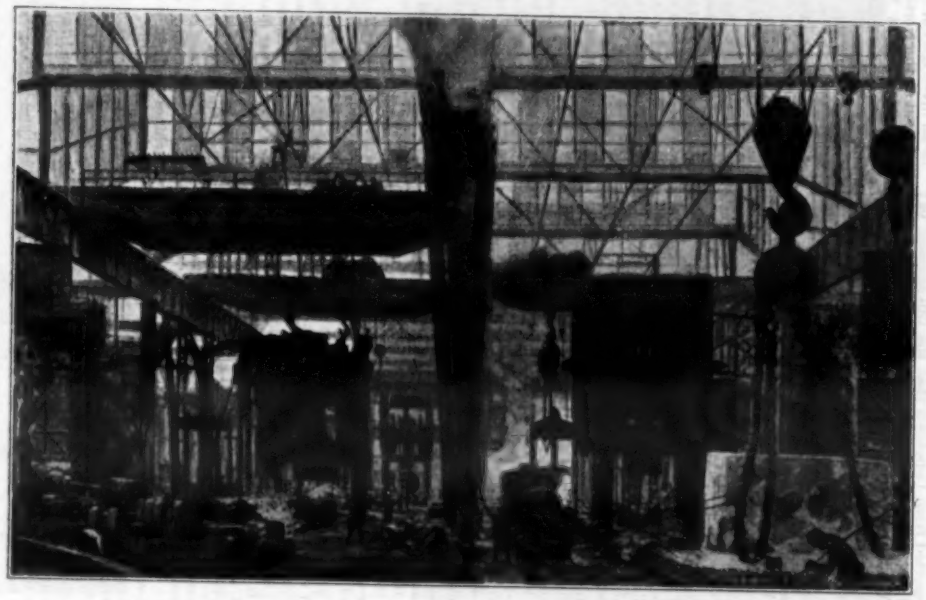


FIG. 8—PRESS SHOP, No. II.

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SOUTH AMERICAN BRANCH OFFICE OF

The Engineer.

526, Bolsa de Comercio, Buenos Aires.

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THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.
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By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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TWO-PAGE SUPPLEMENT—BOILER-HOUSE EXTENSIONS OF THE NEASDEN POWER STATION OF THE METROPOLITAN RAILWAY.

DEATHS.

SUDDENLY, from pneumonia, MONTAGUE BROWN MOUNTAIN, M.I.E.E., of Home Glen, St. Margarets-on-Thames, aged 58.

ON the 2nd December, at Basford Hall, Nottingham, GEORGE FOWLER, J.P., M. Inst. C.E., M.I. Mech. E., aged 81.

On the 28th November, at Fairlight View, Hawkhurst, ADOLPHUS WILLIAM ACKERMANN, M. Inst. C.E., formerly of Cape Town, South Africa, eldest son of the late Adolphus Ackermann, of London, in his eighty-first year.

THE ENGINEER.

DECEMBER 9, 1921.

Noise.

IF to future generations records descend of the noises of our streets, houses, workshops, trains, motor cars, public orators and New York, surely men of those days will marvel at the hardiness of a people that could tolerate such a pandemonium, and be astonished at the small capacity of our lunatic asylums and aural clinics. From our cradles to our graves we live in the midst of an appalling row, of which the magnitude only becomes evident for two minutes in every year when, in a silence that can be felt, we honour those who fell in the Great War. The difficulty that we have in appreciating the persistence of noise and the lack of means of measuring the injury it causes, and even its amount, is one of those things which should teach us to hesitate when we are about to condemn the follies and iniquities of past generations. We do not doubt for an instant that future orators and writers will hold up to opprobrium the cruelty and hardships imposed by the noise in factories during the first half of the twentieth century, just as our present orators and writers condemn the insalubrity, darkness and cruelty of the factories of a hundred years ago. No generation can see itself as later generations will see it, and it is generally ignorant of its faults because it lives in them and is as unable to measure them as it is to gauge the depth of space or the volume of the ether. Let us, admitting that we are making outrageous mistakes, be tender to the errors of preceding ages and thankful that now and then our faults reveal themselves to us and, through our written recognition, enable us to show future historians that we had some desire to remove them.

The very point that we have been discussing makes it extremely difficult to write convincingly on the subject of noise. We recall, many years ago, a young man having the hardihood at a conference of the Institution of Civil Engineers to suggest that means should be taken to modify the noise of boiler and tank shops caused by pneumatic tools. He was stared at in wonder, and many a derisive smile was seen on the face of the works managers present. Noise, what was it? Something intangible, unimportant, of no consequence in comparison with the output derived from pneumatic caulkers and chippers. Times have changed, the new science of workshop hygiene has sprung up, and sympathetic hearing would be accorded now to anyone who urged the suppression of noise. Very, very slowly people are beginning to understand that noise has an effect upon the human system comparable with that of impure air, that it causes lassitude and irritability and decreases the rapidity and quality of work. This recognition is the first step towards reform; it has been harder to secure than might have been expected, but was easiness itself compared with the actual realisation of the object sought. A certain amount of work indeed has been done in the suppression of noise, as, for example, in the underpadding of railway vehicles, the silencing of gas and oil engines and other explosive machines, and in the improvement of gearing. But our ignorance of the methods of reducing noise is still profound. Take, as a single example, the roar that is produced by high-pressure gas in furnaces, or even the annoying hiss of a gas fire. Its reduction looks a fairly simple problem, but it has constantly defied and is still defying clever experimentalists and investigators. Even the cause of the noise, or, at any rate, the seat of it, is not as obvious as might be expected. In the case of high-pressure burners for lighting the roar is such a serious drawback that until it is conquered the efficiency that would accompany high-pressure gas lighting has to be surrendered in all save open situations. Turn now to motor car engineering. It is shown daily by a few of the best makers that silence is attainable, yet we continue to tolerate a wholly inexcusable racket from open exhausts, noisy gears, and shaky joints. It is only by setting our faces against such offences that we can hope ever to overcome them, and much as motorists may oppose restrictions on their liberty to offend the ears of the public, a greater end will be served by multiplying those restrictions than by softening, removing, or withholding them. In all machinery noisiness and bad engineering go hand in hand. Noise always tells of work wasted in friction or knock. By decreasing it we shall increase efficiency. Take, again, the noise of railway trains. The bulk of it comes from the rails, and particularly from the joints. Efforts have been made to obviate the joint, by scarfing and so on, but they have failed. Yet the power absorbed in bumping over joints, and the wear and tear of material that ensues makes the continuation of the search worth while. But whilst its origin may still defy us, we could keep the noise itself in subjection. It is now multiplied by the hollow carriages, which act as sound boxes. Insulation between the underframe and the body has done much to reduce the nuisance by preventing its magnification. But much remains to be done. It should be possible to make the interior of a railway coach as silent as a sitting room. The noises of the workshop are still more difficult to handle, but if the attempt is made, if managers resolve that they shall be minimised, then somehow, somewhen, the end will be achieved. Even the simple plan of fastening an old leather belt around a boiler that is being caulked may do something to reduce the vibration. But a more scientific line of research is open. It is pretty certain that the noises of a big workshop have a pretty constant period of vibration. Can it be treated as a single note and opposed by another note of appropriate frequency, like two vibrating tuning forks rendered silent by interference?

One of the greatest troubles in the handling of noises is the lack of reliable apparatus for measuring quantities of sound. Simple as the problem of designing an instrument of the kind appears, it has not yet been wholly solved, and as its solution is the first step towards the reign of silence it may be commended to the attention of physicists and inventors. Armed with an instrument of the kind, it would be possible to legislate for the removal of noises; lacking it, legislation of the kind is well-nigh impossible, because there is no measure on which to base a definition of objectionable sounds. But, after all, the first thing is to recognise that noise is injurious, that it does harm the nervous system, that it does interfere with the quality of work, that it does cause lassitude and provoke irritability. When that has been done we shall soon be on the way to its diminishment.

The Less Known Metals.

CONSIDERABLE time has elapsed since we urged in these columns, the necessity of giving attention to the engineering and industrial importance of the less known metals. We pointed out that it was in connection with the materials whose properties were as yet comparatively unexplored that really important technical advances were most likely to be made, and that if we neglected these materials and allowed others to monopolise their study those others would also inevitably come to monopolise the exploitation of these materials when important uses for them had been found. Although thus venturing into thes phere of prophecy—on something like certain ground, however—we did not anticipate that in little more than a single year we should have the melancholy satisfaction of being in a position to say "We

told you so." Nevertheless, such is actually the case at the present moment, and we find British industry once again faced with the task of trying to make up leeway because it has allowed a scientific and technical advance to be made abroad on a subject of very great industrial importance to itself.

Among the less known or "minor" metals to which we have referred is the metal titanium, which has hitherto been regarded in the light of a metallurgical bugbear whose presence makes it difficult, if not impossible, to work a considerable quantity of otherwise valuable iron ore. If, however, the titanium itself became of value so that its removal from the ore became commercially possible, the whole position of this matter would be fundamentally changed, much to the advantage of British industry. It would have seemed almost obvious, therefore, that a matter of such national British importance would have been made the subject of vigorous and systematic study and research, and if it has been neglected it is not, as we have shown, because the importance of work of this kind has not been pointed out. Yet the discovery which has led to the first really important industrial application of titanium has been made abroad. It amounts, briefly, to this, that titanium oxide, when sufficiently purified, is a pure white substance of very great covering power when used as a pigment in oil paints. The purified oxide may thus become a serious rival to white lead, provided that it can be produced cheaply. It has the very important advantage that it is non-injurious as against the seriously poisonous character of the lead pigment, and chemical reasons indicate that it is likely to resist discolouration far better than lead, particularly in or near cities where sulphide fumes are found in the atmosphere. We have, thus, at one stroke, a development which seriously affects two important industries—the white lead and paint industry and the iron industry, since it attaches an entirely new value to titaniferous ores. At the present moment, however, the manufacture of so-called "Titan White" is a foreign monopoly, and once again British research and initiative have been left behind. No doubt strenuous efforts will be made to secure a proper share in this industrial development for British industries, but they are efforts "after the event," and we cannot hope to win the race by always following in the wake of others. We do not, however, wish to labour unduly the intrinsic importance of this particular case, but rather to stress its value as an apt illustration of the serious and urgent importance of studying new and unexplored materials. It is true, of course, that no one can foretell where the next important step in technical progress is to come, and it may arise in some field which we now regard as well known and thoroughly explored. Yet, on the face of it, there seems to be more likelihood of rapid advance in the less known fields, of which there is no lack. Taking the metallic elements alone, not more than about 60 per cent. are even approximately well known in regard to their properties, mode of preparation, and their behaviour in alloys. Of the remainder it is true that a number are either very rare or apparently unpromising. We must remember, however, that metals which were rightly regarded as "rare" at one time are now in common industrial use, while materials of seemingly unpromising character may, on closer study, prove of special value for some particular application.

The whole matter bears a strong resemblance to the problem of geographical exploration as it stood in the days when the foundations of the British Empire were being laid by explorer and pioneer. In both fields of exploration the fruits are, ultimately, open to the whole world, yet the nation which carries out the pioneering work reaps the first fruits. What is true of geographical dominion is true in a higher degree of intellectual and technological dominion; once again—we cannot afford merely to follow the lead of others. It may, at the present time, be difficult to find funds for exploratory work of any kind; "economy" is so easily effected—apparently—by cutting down those things whose value is only evident to the instructed and far-seeing. Still, it may be hoped that both the Governments of our Dominions and our own Research Department, as well as some of the larger firms interested in the exploitation of mineral resources, will see the need of supporting strongly, and at once, some concerted effort to find the ways and means of developing the inherent values which reside in the minerals that contain some of the less known metals.

It may be mentioned that Mr. F. Huth Jackson, whose death has recently been announced, was not only a director of the London and South-Western Railway, but was a member of the abortive Royal Commission on the Relations between Railways and the State of 1913–14, presided over by Lord Loreburn.

Literature.

Nos Usines Métallurgiques Dévastées (1914–1918). Monographies de Quelques Grandes Usines Métallurgiques Françaises detruites par les Allemands, rédigées par un groupe d'ingénieurs, avec introduction par Monsieur Leon Guillet. Paris, IXe: Editions de *La Revue de Métallurgie*, 5, Cité Pigalle, 5. 1921.

There has recently been published by our esteemed contemporary, *La Revue de la Métallurgie*, under the title of "Nos Usines Métallurgiques Dévastées," a series of monographs dealing with the destruction wrought by the Germans during the war on numerous steel and other works in the occupied territory. Each monograph is illustrated by engravings and each has been prepared by an engineer or metallurgist having full knowledge of the circumstances existing both before and after the Germans gained possession of the works.

In an introduction to the volume, prepared by Monsieur Léon Guillet, Professor of Metallurgy at the Conservatoire des Arts et Métiers, and at l'Ecole Centrale des Arts et Manufactures, the reader is reminded that French territory was invaded to the extent of over 3,600,000 hectares—8,895,500 acres—for a period of over four years, and that the districts thus overrun were, unfortunately, the most important in the country both as regards natural wealth and trade. The loss in human life amounted to no less than 1,383,000, that number being made up of 1,122,000 killed and 260,000 "missing," and representing 16.44 per cent. of the total number of those who joined the colours. By way of comparison it is pointed out that Great Britain, her overseas Dominions, her Colonies and Dependencies, lost together 869,000 men killed and missing, and the United States 114,000, those numbers being 63 per cent. and 8.3 per cent. of the French losses respectively. At the time of the Armistice 11,500 French works, which originally gave direct employment to some 379,000 persons, had been destroyed. In addition, 319,269 private dwellings had been totally razed to the ground; 313,675 dwellings were partially demolished; while 32,500 miles of railways, 24,400 miles of roads, 1000 miles of canals, and 4875 bridges and viaducts required complete relaying or reconstruction. Some of this damage could doubtless be defended on the ground of military necessity, but a large proportion was, it is explained, and as, in fact, all the world knows, systematically and deliberately carried out with the sole object of ruining French industries and of easily gaining after the war a marked economic supremacy. In every industrial installation of the invaded regions, no matter how far it might be removed from the scene of active hostilities, everything which the enemy could not remove and take to Germany during the time that the war lasted, was wantonly destroyed by sledge hammer or explosive charge, the destruction having been effected, in many instances, only a few days before the signing of the Armistice.

The works dealt with in the volume are those of:—(*a*) La Société des Hauts-Fourneaux, Forges et Aciéres de Denain et d'Anzin; Noyelles Godault, originally belonging to La Société de Malfidano, but since disposed of to La Société Minière et Métallurgique de Peñaroya; La Société Française de Constructions Mécaniques at Denain; La Société L'Aluminium Français at Mennesis; La Compagnie des Forges et Aciéries de la Marine et d'Homécourt at Homécourt; Les Etablissements Arbel at Douai; Wendel et Cie. at Jœuf and Messempré; Les Etablissements Delattre et Frouard Rénnis at Ferrière-la Grande; La Société Anonyme des Fonderies et Laminoirs de Biache-Saint-Vaast; La Société Anonyme des Aciéres de Micheville; La Société des Aciéries de Longwy at Mont-Saint-Martin; La Société Anonyme des Forges de la Providence at Rehon and Hautmont; La Société Métallurgique de Montbard-Auloyne at Auloye; La Société Métallurgique de Senelle-Maubeuge at Senelle; La Société Mineur, ses Fils et Wilmot at Vireux-Molhain; Les Etablissements des Forges et Aciéres du Nord et de l'Est at Valenciennes, Louvroil, Pont-à-Vendin, and la Mine de Pienne; La Compagnie Française des Métaux at Givet; and La Compagnie Métallurgique Franco-Belge de Mortagne at Mortagne-du-Nord.

The photographic illustrations which accompany these monographs bear only too faithful testimony to the ghastly thoroughness with which the enemy performed the work of devastation. In many instances views are given of works or workshops before and after the advent of the German hordes, so that some sort of an idea—poor it may be as compared with reality—can be formed of the devilish—it is really not too strong a word—concentration devoted to making the destruction complete in every case. Not content with the removal of the entire contents of a works, the foe must needs break down with meticulous completeness the structures which contained the machines or tools or other equipment. There is unmistakable evidence that it was his definite and set purpose so ruthlessly to ruin such industrial establishments as came within his grasp that it must be months and possibly years before they could be reinstated. If removal was impossible then most ingenious methods of demolition, including the scientific employment of explosives, were resorted to. In not one single case was a workshop, a foundry, a furnace, or a mine shaft left in workable condition.

There is, however, thanks to the indomitable spirit of the French nation, a brighter side of the picture. It is true that it was France's misfortune that so many of her industries were centred in, and so great a proportion of her raw materials came from, the areas which were at the outset overwhelmed by the German inundation. It is true, too, that the war deprived the country of quite 50 per cent. of its coal output, and that as a further 24 per cent. had been derived from the zone occupied by the Allied Armies, there only remained available 26 per cent. of the pre-war output. True it is, also, that in the same way the country at the outbreak of hostilities immediately lost some three-quarters of its coke output; that the production of iron ore fell to 17 per cent. of the normal; that that of pig iron diminished to about the same percentage; that that of steel was only some 26 per cent. of what it had been a few months before; and that there was much the same experience with other metals and, in fact, with practically every industry. But the nation was far from resting inactive. Immediately following the battle of the Marne, we are told, the necessity to face the situation squarely was recognised, and steps were taken to make good the supply of the munitions of all kinds demanded by the intensive actions which were taking place. Under the influence of Monsieur Millerand, who was at that time Secretary of State for War, there occurred throughout the country a most pronounced reaction which was soon crowned with success. New works were put down and they were equipped in so extraordinarily short a time that very rapidly they reached a quite unprecedented output. Notwithstanding the lack of fuel, the pig iron production, which, from being 5,207,000 tons in 1913, had fallen to 989,400 tons by the end of 1914, rose to 1,684,000 tons by 1917, whilst steel production, which in pre-war times had been 4,687,000 tons and had fallen to 1,375,000 tons, rose during the period of hostilities to 2,231,000 tons. There was much the same tale to tell in connection with the non-ferrous metals. Furthermore, the war over, France, having with the aid of her Allies first of all successfully stemmed the tide of invasion and next brought the enemy to his knees, set herself actively to reconstitute her trade and industries. Her works are springing up once more, and those that have been so reconditioned are better equipped than they were before. Some of the illustrations show what great things have been done since the Armistice was signed, and though much remains to be done, and though it may be some years yet before her mines have reached their pre-war figures and before her industries are thoroughly reinstated, it is safe, after carefully studying the volume before us, to predict that the French nation will in the end win through triumphantly, and that, notwithstanding that she, like other nations, has had, and will have, her labour troubles, yet France still sorely needs money and materials and is still lamentably short in man power.

In conclusion, we may, perhaps, usefully quote, as follows, from the foreword of the publishers:—"Ce livre s'adresse à tous les bons Français qui, ne pouvant pas oublier, veulent que leurs enfants se souviennent, à tous les alliés et amis de la France, à toutes les consciences droites, éprises de justice et de vérité."

BOOKS RECEIVED.

Cardiff: The City of Golden Opportunities for the Manufacturer. Cardiff: Issued by the Development Committee of the City Council. Free on application.

Robertson's Method for Export and Import Trade. By J. Robertson. London: Scott, Armstrong and Co., 79, Coleman-street, E.C. 2. Price 2s. 6d. net.

The Mechanical Handling of Goods. By C. H. Woodfield. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 2s. 6d. net.

Earthwork in Railway Engineering. By J. W. F. Gardner. London: Constable and Co., Limited, 10–12, Orange-street, Leicester-square, W.C. 2. Price 15s. net.

Gears and Gearing. By Captain S. Bramley-Moore. Bradford: Percy Lund, Humphries and Co., Limited. London: E. J. Larby, Limited, 30, Paternoster-row, E.C. 4. Price 12s. 6d. net.

Bleaching. Being a *résumé* of the important researches on the industry published during the years 1908–1920. By S. H. Higgins. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 10s. 6d. net.

The Electric Furnace. Describing the construction, working and applications of all types of electric furnaces. By F. J. Moffett. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 2s. 6d. net.

Boiler Laws Committee Report, 1920–21. Delhi: Superintendent, Government Printing. London: Department of Commerce and Industry, Government of India, Indian Trade Commissioner, 60, Winchester House, Old Broad-street, E.C. 2.

History of the Great War: Based on Official Documents by direction of the Historical Section of the Committee of Imperial Defence. Volume II., Naval Operations. By Sir Julian S. Corbett. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 21s. net.

Ministry of Finance, Egypt: Note on the Programme and Policy of the Government with regard to the Investigation and Development of the Petroleum Resources of Egypt. By E. M. Dowson, C.B.E. Cairo: Government Publications Office, Old Ismailia Palace, Sharia Qasr el Aini. Price P.T. 10.

Tanks and Chain-Track Artillery.*

By L. A. LEGROS.

No. II.†

THE FRENCH TANKS.

SCHNEIDER.

As has been stated above, the first French tanks were built by the firm of Schneider. The 400 (C.A. Type) tanks that had been ordered from them on February 25th, 1916, were of 13 tons weight. The first batch was delivered in September of the same year. See Fig. 14 on page 594 of our issue of December 2nd, and Fig. 15. The armament of these cars consisted of a 75 mm. short gun in front and two machine guns at the sides. The motor was of 60 horse-power, four cylinders 135 mm. by 170 mm. (5.3in. by 6.7in.), three-speed change gear with sliding gears, auxiliary 10 horse-power motor driving through a high-ratio reduction gear.

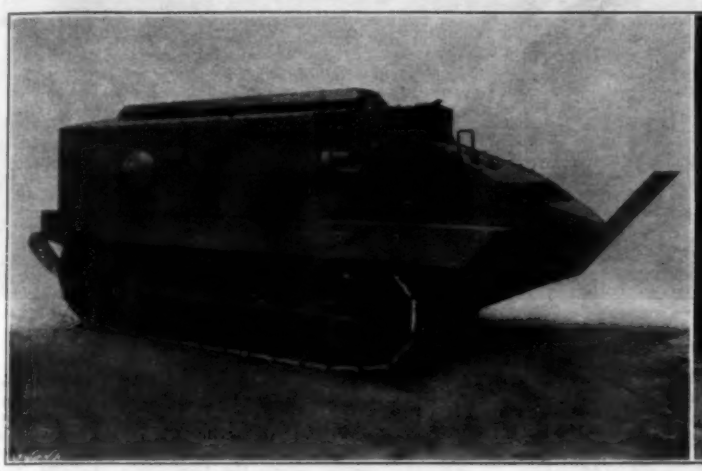


FIG. 15—SCHNEIDER "CHAR D'ASSAUT"

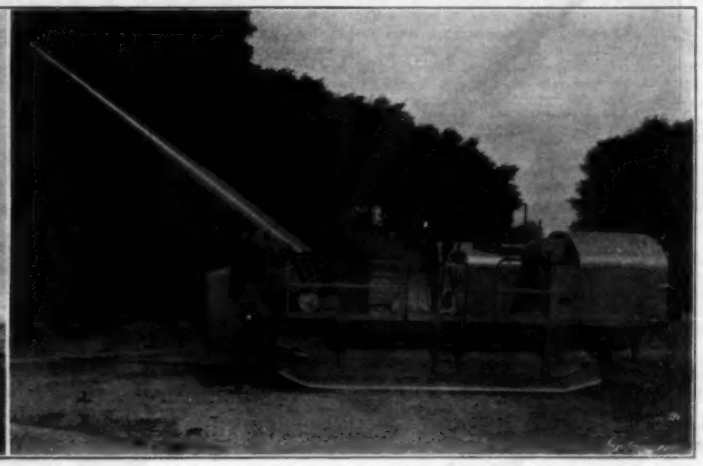


FIG. 16—SCHNEIDER LONG 220 MM. GUN-CARRIER

SAINT-CHAMOND.

In 1915 also the Forges et Aciéries de la Marine et d'Homécourt, under the direction of Colonel Rimailho, began experiments and designs for a tank, the first example of which was commenced in May, 1916. Trials of this took place in July, and the manufacture of 400 tanks of this pattern—see Fig. 17—was commenced in November of the same year. This tank was fitted with a motor of 90 horse-power, running at 1450 revolutions per minute, of the four-cylinder, sleeve-valve Panhard type. The speeds from 2 kiloms. to 8 kiloms. per hour (1.2 to 5 miles per hour); steering was effected by declutching and braking one of the chain tracks. The arrangement of the chain tracks comprised two jointed truck frames on each side carrying the suspension springs with a transverse compensating lever in front. The crew consisted of seven men.

Apart from the tanks, the firm of Schneider constructed other chain track artillery during the war, as follows:—

(a) *Tractor Lorries*, of the C D type, capable of carrying a load of 4 tons, and giving a draw-bar pull of 7 to 8 tons. These tractors used for the greater part the mechanical details of the C.A. tank, except that the change-speed gear had four speeds. The motor was the same, as also was the arrangement of the chain tracks.

(b) *Carrier Tractor*, of the C D 3 type, capable of carrying a 155 mm. gun, either long or short, or a 220 mm. howitzer. This vehicle was fitted with a crane and a capstan, as well as the gear necessary for enabling it to pick up its load in a few minutes. Weight, 12 tons. Motor the same as in the preceding type C D; speeds from 1.2 kiloms. to 6 kiloms. (0.6 to 3.7 miles) per hour; draw-bar pull in first speed, 10 tons.

(c) *Self-propelled Chain Track Mounting for 220 mm. Long Gun.*—The gun, which can be fired at a maximum angle of 37 deg. to the horizontal—see Fig. 16—is carried on its small normal type of mounting, which rests on two inclined roller paths forming part of the chassis of the vehicle. A hydraulic brake is interposed between the small mounting and the chassis. The return to loading position is effected by gravity. The motor was six-cylinder of 120 horse-power; total weight, 40 tons. The gun was laid roughly for direction by means of the chain tracks, traversed by the main motor, and the fine adjustment effected either by a hand wheel or by a small auxiliary motor driving through a high-ratio reduction gear.

The armouring was as follows:—On the sides two plates, having a total thickness of from 15 mm. to 17 mm.; in front, 11 mm. plate inclined at 45 deg.; at the back, 8.5-mm plate; and for the roof, 5.5 mm. plate. The total length of the tank, exclusive of the projecting barrel of the gun, was 7.91 m. (26ft.), and its width was 2.67 m. (8ft. 9in.); the maximum height was 2.365 m. (7ft. 9in.); the ground clearance, 0.500 m. (19.7in.); the width of the chain track was 0.500 m. (19.7in.); the length of bearing with 0.050 m. (2in.) sinkage was 3.350 m. (11ft.).

This tank carried a 75 mm. quick-firing Saint-Chamond gun or an 1897 pattern 75 mm. gun, with its supply of cartridges. The contents of the petrol tanks were 265 litres (58 gallons), distributed among three petrol tanks. This supply was sufficient for running a distance of 35 kiloms. (22 miles) on slow speed and of 60 kiloms. (37 miles) on top speed. Steering was effected by means of a steering hand wheel acting on contactors, the closing or opening of which enabled different combinations of the internal connections of the electric motors to be made or broken. These combinations acted by accelerating the outer motor and slowing, braking or locking the inner motor on the curve.

It is of interest to note that the Saint-Chamond firm had the idea of using a carrying chain track in the front of the vehicle—see Fig. 18—for assisting in climbing obstacles, as had been proposed by Colonel Swinton. This design, however, was not actually executed. The Saint-Chamond firm also designed and built carrying tractors for the 120 mm. long quick-firing gun, as well as a motor chain track gun mounting carrying a 120 mm. long type long-range gun. The large chain-track artillery constructed by the Saint-Chamond firm consisted of two chain-track vehicles per unit, and is particularly worth attention. The two vehicles in running position are in both cases carrying a 194 mm. Mark F gun—shown in Fig. 19, and

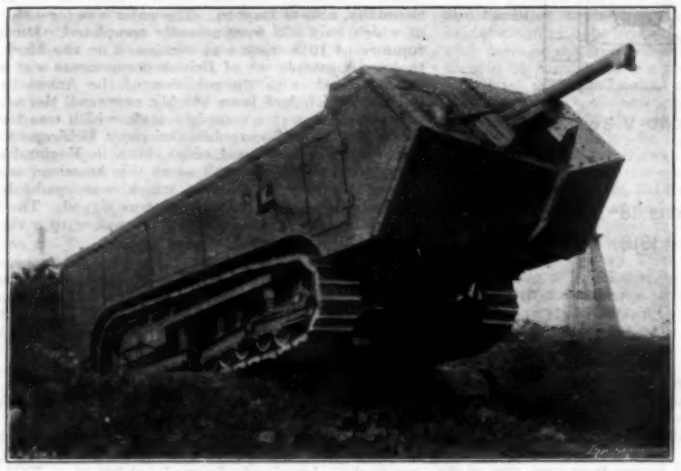


FIG. 17—ST. CHAMOND TANK

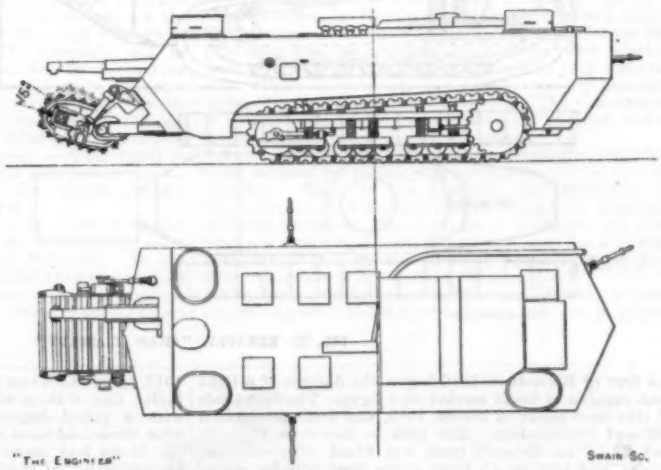


FIG. 18—ST CHAMOND TANK, WITH SUBSIDIARY TRACK IN FRONT

FIG. 19—ST. CHAMOND PETROL-ELECTRIC CAR HAULING GUN

* Abstract of paper read before the British Section of the Société des Ingénieurs Civils de France. September, 1921.

† No. I. appeared December 2nd.

the gun in firing position is shown in Fig. 20. In another instance a 280 mm. short howitzer was carried—see Fig. 21.

The unit in each case consisted of two chain-track vehicles. The forward motor chain-track vehicle, fitted with an electric generating set, carried the ammunition. The chain-track gun mounting was fitted with two electric motors, and supplied from the generating plant on the forward vehicle by means of a cable 50 m. (55 yards) long. On uneven country the vehicles were generally run independently of each other. If the slope or condition of the ground required it, the two vehicles could be moved one after the other, and thus make progress by successive stages.

FIG. 20—ST. CHAMOND ELECTRIC CAR WITH GUN IN FIRING POSITION

FIG. 21—ST. CHAMOND ELECTRIC CAR WITH 280 MM. HOWITZER

RENAULT.

Following the particulars given by General Estienne, the firm of Renault in 1916 began the designs of a light tank capable of being carried on a lorry. The first trials of this were made in March, 1917, and mass production followed immediately. The tank is shown in Figs. 22 and 23. The Renault tank was fitted with climbing tracks, and had an 18 horse-power four-cylinder motor with the change and driving gear at the rear of the tank. The armament consisted of a machine gun carried in a revolving turret. The suspension gear was arranged at the ends of the chain track frames, which were independently sprung. The vertical armour consisted of 16 mm. plate; plates slightly inclined to the vertical were 8 mm. in thickness; the plates, horizontal or slightly inclined to the horizontal, were 6 mm. in thickness. The method of springing the chain-track frames consisted of plate springs, compensating levers and bogies, which ensured a sensibly constant and uniformly distributed load over each of the carrying rollers, whatever might be the irregularity of the ground to which the chain must adapt itself. The tank was controlled entirely by one man. The turret, carried on a ball race, could be swung round its vertical axis, and the machine gun or quick-firing gun could cover the whole of the horizon. Steering was performed by unclutching the chain drive on the side to which it was desired to turn, and by locking it if required to turn on the spot. To facilitate the running of the tank over trenches, a removable tail was fitted behind the armouring. The average weight was 6.7 tons.

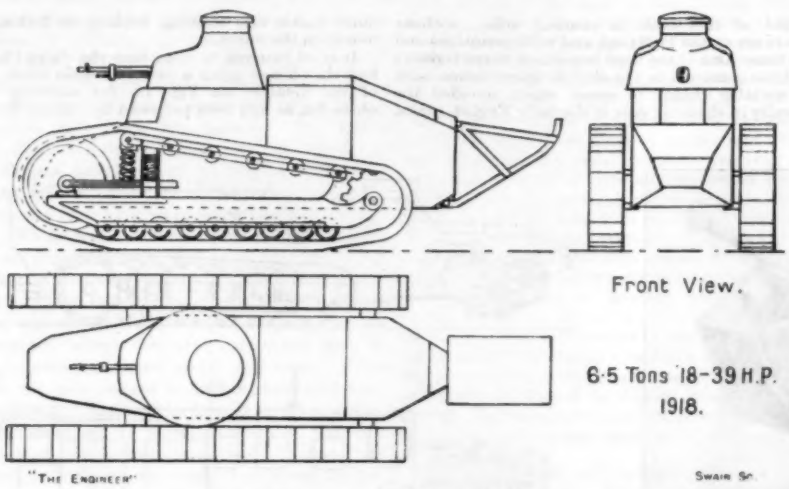


FIG. 22—RENAULT "CHAR D'ASSAUT"

THE AMERICAN TANKS.

When America entered the war very little authentic information covering the use and types of tanks was available in that country. Some rather vague specifications were obtained from France during the summer of 1917, from which two patterns of experimental tanks were built. One of these was steam driven, the other equipped with a petrol-electric drive. Before the experiments with these had been concluded, the great importance of the tanks had made itself apparent. The "Ordnance Department" of the United States then sent one of its officers to Europe on a special mission with the object of securing all available information relating to the construction and use of the tanks. After numerous conferences with the British and French authorities, America undertook the construction of two types of tanks for the American Army—the small two-man tank, based on the French Renault tanks, and the large 30-ton tank to be produced jointly with England.

Renault tanks were purchased and sent to America, with a complete set of drawings, and instructions were given to duplicate these tanks, using American standards of manufacture and measurements. The designs and specifications relating to the large Anglo-American Mark VIII. tank—see Figs. 10, 11 and 12 *ante*—were completed after numerous conferences with the British General Staff, and the orders were then put in hand for simultaneous manufacture in England and America. According to a treaty signed by the two countries on January 22nd, 1918, the Commissioners appointed under this treaty were empowered to complete the designs, to arrange for the production of British and American components, build a factory in France for the assembly of these components, and actually assemble the tanks. The designs were commenced in November, 1917, and by May, 1918, practically all of the drawings had been received in America, where the production of parts, including motor, transmission, radiators and chain-track rollers and sprockets was to take place. The British Government undertook to supply the chain tracks, armour, framing and armament. The British works had greater experience in the production of armour plate, and possessed a large stock of guns and other fittings necessary for the armament of the tanks.

During this period the construction of American tanks of the Renault type—see Fig. 24—proceeded, and the assembly was entrusted to three large American works—the Van Dorn Ironworks, Cleveland, Ohio; the Maxwell Motor Company, Dayton, Ohio; and the C. L. Best Company, also of Dayton. The order was for 4440 tanks, of which only 950 were actually completed. During the summer of 1918 work was continued on the Mark VIII. tanks. A sample set of British components was sent to America and, with the addition of the American components which had been quickly prepared, the assembly was carried out of a complete tank, which was tested at the works of the Locomobile Company, Bridgeport, Conn. Everything was in good order, both in England and in the United States, as well as at the American works at Neuvy-Pailloux, in France, which was ready for full production, when the Armistice was signed. The manufacture of 1500 tanks was then in hand, with a view to a heavy delivery in the spring of 1919.

America, moreover, had undertaken the construction of 1450 complete tanks from parts manufactured entirely in the United States, in addition to the components which were already being made in the United States. During the summer and autumn of 1918 a 3-ton tank—see Fig. 25—much smaller than the Renault, was designed by the "Ordnance Department," to be constructed by the Ford Motor Company, of Detroit. These designs made use as far as possible of the standard parts of the Ford automobile. Just before the signing of the Armistice, orders were placed for 15,000 of these 3-ton tanks, which were intended to be used either as light tractors or as machine gun tanks. America had completed 100 Mark VIII. tanks in the spring of 1920 for the service of the "American Tank Corps."

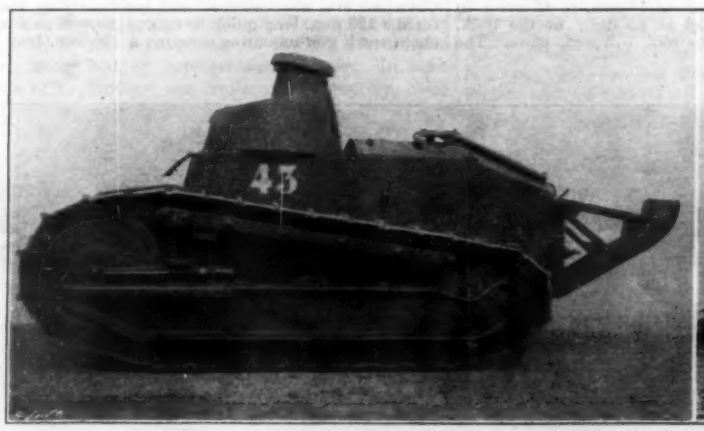


FIG. 23—RENAULT "CHAR D'ASSAUT"

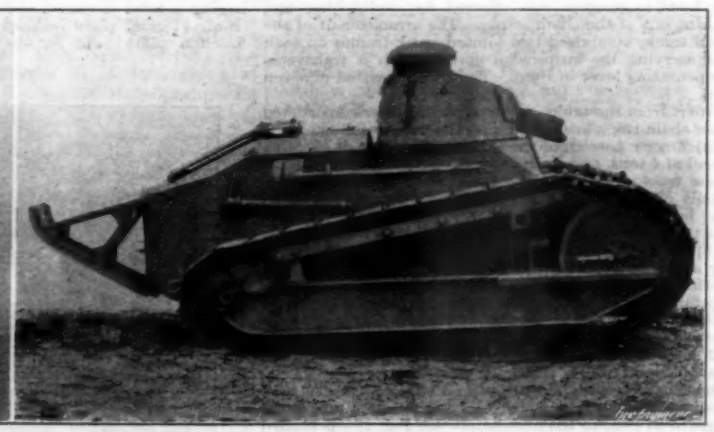


FIG. 24—AMERICAN TANK OF THE RENAULT TYPE

Chain-track artillery has been studied in America‡ on principles identical with those adopted in France. Experiments made by the firm of Holt as far back as 1916 showed the possibility not only of carrying a 200 mm. howitzer, but also of firing it from the chain-track mounting. More than six definite patterns have been constructed, the armament of which comprises the 155 mm. long gun and

‡ *Journal* of the United States Artillery, January, 1921.

the 240 mm. howitzer carried on automotor chain-track mountings. Of these, the most remarkable is the Christie automotor mounting, having four wheels at each side, 915 mm. (36in.) in diameter, and a chain track carried below the mudguard and capable of being put into place in 15 min. For this last operation, the intermediate wheels which on the road are raised out of contact with the surface are lowered, and the steering gear of the front wheels is locked. Steering is then effected by declutching on chain track, as in the tanks. The wheels are fitted with solid rubber tires, giving a speed of 27.5 kiloms. (17 miles) per hour on the road. The chain track is fitted with snugs, which engage with notches in the wheels between the double solid rubber tires. The speed attained on the chain tracks is about 14.5 kiloms. (9 miles) per hour.

THE ITALIAN TANKS.

By the order and at the expense of the Italian Government, designs for the construction of tanks were undertaken by the Fiat firm at Turin—see Fig. 26. The tank was of heavy pattern, weighing 35 tons, with a 250 horse-power motor and a maximum speed of 12 kiloms. (7.4 miles) per hour. The armament consisted of a short gun carried in a revolving turret.

FIG. 25—3-TON TANK MADE BY THE FORD COMPANY

The Fiat firm is at present engaged on the construction of a lighter tank—see Fig. 27—the weight of which is about 6 tons. The motor is of 45 horse-power, running at a normal speed of 1500 revolutions per minute, and giving a maximum speed of 16 kiloms. (10 miles) per hour. The armament consists of two coupled machine guns arranged in a revolving turret.

THE GERMAN TANKS.

It was not till near the end of the war that Germany began the construction of tanks. The type produced by them bears no trade of the improvements which had been gradually introduced into the design of this engine of war by the Allies. It is more particularly in methods of defence against tanks that the Germans made the greatest progress in this branch of warfare :—

(1) By the adoption of a gun taking a cartridge almost double the linear dimensions of the ordinary infantry rifle cartridge.

(2) By the construction of hidden excavations modelled on the elephant pit, with the object of trapping the tanks which might run over the prepared ground.

(To be continued.)

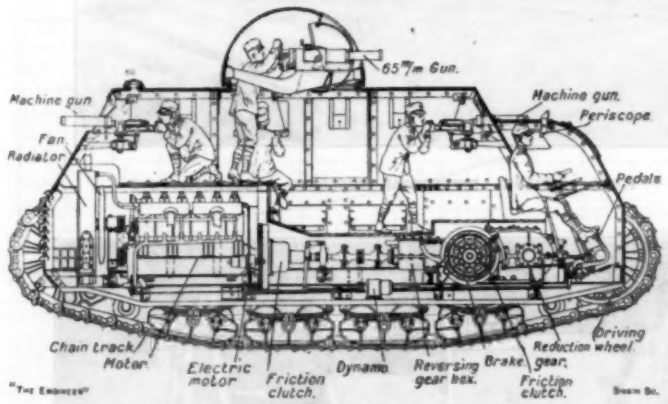


FIG. 26—INTERIOR OF HEAVY PATTERN FIAT TANK

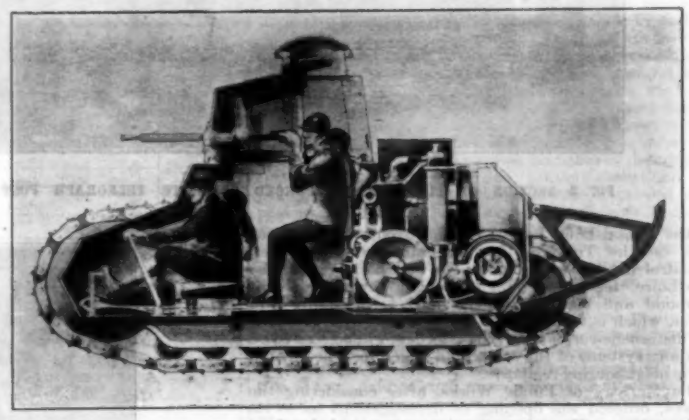


FIG. 27—INTERIOR OF LIGHT PATTERN FIAT TANK

Electrical Progress in Brazil and the Argentine.

WHERE electricity has been employed in Brazil in connection with metallurgy it has been found eminently successful. It is interesting to note that with the inauguration of the establishment at Ribeirão Preto, belonging to the Companhia Electrica Metalurgica Brazilaira, a beginning was marked in South America of the use of electricity for smelting purposes. The company is working in connection with the Empreza Porca Luz de Ribeirão Preto, which is furnishing the necessary power, and the erection of the plant at Ribeirão Preto is reported to be making substantial headway. The full capacity of the works will, it is understood, be 60 tons of steel daily, but it is believed that the plant will turn out only about one-half of that amount during the early months of its operation. The ore is to be mined in the southern part of the State of Minas Geraes, and will be hauled 75 miles to the works at Ribeirão Preto, which enjoys easy rail access to the port of Santos.

An extensive system of electric lighting is to be introduced into the town of Ribeirão Preto, a company, known as the Empreza Força y Luz de Ribeirão Preto, having been formed for the purpose, with a capital of 6,000,000 milreis. The company, by the terms of its contract, undertakes to install and exploit an electric service as well as a calcium carbide factory, and to furnish contracts and facilities in the neighbouring municipalities for the exploitation of light and power services, along with water and sewage disposal systems. The company will be obliged to furnish all the power that may be required for industrial purposes in that zone, as well as to construct and operate a complete irrigation system either on its own account or for the account of third parties. Among the towns, in addition to that of Ribeirão Preto, which the company will undertake to supply, and for which it will hold exclusive privileges of light and power, are :—Gravinho, Sertaozinho, Jardinopolis, Orlandia, Brodowski, Sao Joaquin, Ituerava, and Igarapava.

A hydro-electric plant is about to be installed on the Jucu River, in the State of Espirito Santo (Brazil) in order to supply the city of Victoria with electricity. In the State of Rio de Janeiro various waterfalls are now utilised for supplying electricity to the cities of Rio de Janeiro, Nictheroy, Petropolis and Campos. The city of Sao Paulo is supplied with power by the falls known as the Salto de Paranahyba in that State.

Sufficient progress has been made with the electrification of the Paulista Railway (Brazil) to enable it to be said that the transformed line will be open to traffic by the end of this year. The whole of the electrification for a distance of 44 kiloms. has been carried out by a United States electric company. A contract has also been entered into for the supply of eight electric goods locomotives of 91 tons each and four electric passenger locomotives of 110 tons each, as well as a 4500-kilowatt sub-station equipment to be installed at Louverra. The same contractors will also supply the equipment of the catenary overhead construction. The sub-station will receive power from the Sao Paulo Electric Company at 88,000 volts alternating current and deliver it to the locomotives as 3000-volt direct current. It is proposed to continue the electrification later on to Sao Carles, making the total distance electrified 100 miles. The importance of this undertaking lies, not so much in the fact that the installation will serve both goods and passenger traffic, nor in the length of the line electrified, as in the fact that it marks the adoption by a company known for its progressive policy of the direct-current high-voltage system of heavy electric railway traction.

An electric lighting system is about to be installed in Tubarão, in the State of Santa Catharina.

A concession to construct a hydro-electric plant on the Paraguassú River, in the State of Bahia (Brazil) has been transferred to the Companhia Brazileira de Energia Electrica. A natural fall on the river is being used to develop 5000 horse-power, and construction has been progressing steadily. The plant is expected to be in operation almost immediately, when the company will be in a position to supply the city of Bahia with light as well as power for the tramway system, while the company also expects to supply a number of manufacturing firms and sugar refineries with power, which will reduce the demand for coal and fuel oil, now being used at great cost.

A hydro-electric plant has been put into operation by the Companhia Valenca Industriál. It is built on the falls of the Una River, and, besides providing power for a textile factory belonging to the company, it will supply the city of Valenca with electric light. The hydro-electric plant on the river Jaguaripe, owned by the firm of E. Tude and Co., of Bahia, has been increased in capacity, the new plant being intended to supply power for the vegetable oil refinery of the firm mentioned. The greater part of the installations, plant and machinery for these hydro-electric establishments has been received from the United States and the remainder from Europe, principally from Germany and Switzerland.

The dependence of Brazil upon foreign sources for fuel, there being no coalfields available, has caused the Government to give special attention to the electrification of the railways of the State, and a British company has now presented elaborate plans for the electrification of the whole of the lines of the State of Sao Paulo. The proposition of a general programme of electrification has long been under consideration, the most important railway in this district having already taken steps to carry it out upon its own system. The development of the hydro-electric industry had already reached a high point before the war. Forty-seven plants, developing approximately 112,000 horse-power, were in operation in 1914, the largest developing 50,000 horse-power and furnishing sufficient current to operate nearly all the manufacturing enterprises in the State of Sao Paulo. Arrested by the war, development of the industry is now again showing extension, and may be expected to progress still more in the near future, a fact worthy of the attention of British manufacturers of hydro-electric plants.

The port work authorities at Buenos Aires lately called for tenders for the supply of about twenty electric cranes and motors. Over ten firms tendered, and the estimated cost of the articles ordered exceeds 800,000 pesos m/n.

Whereas Argentine was formerly a leading market in South America for foreign-made electrical devices, several local factories have lately been established and are fast providing domestic requirements, a move which is calculated to lessen importations of such goods very considerably. Many factories are now turning out dry batteries, carbon brushes, and insulating conduit. The manufacture of incandescent lamps has also been commenced, but so far the business has proved unsuccessful.

In Argentina there are three well-established organisations devoted to engineering, of which two are purely electrical. They are the Instituto Sud Americano de Electrotécnicos y Mecánicos and the Asociación Argentina de Electrotécnicos. The members of the former are principally wiremen and station operators, and the Institute, therefore, is in a good position to disseminate practical information where it will effect the most good.

The Asociación Argentina de Electrotécnicos is composed almost entirely of certificated engineers, who are in private practice or in the employ of large companies or of the Argentine Government. Regular meetings are held, at which papers are read upon subjects of current interest, while frequent visits of inspection to local electric works are arranged.

A French engineering company has been granted a concession by the Argentine Government for the erection and working of a wireless station for direct communication with France. The concession is for a period of thirty years, and the company is allowed three years for preparation before commercial service is demanded. By the terms of the agreement the company's wireless messages will be forwarded over the State telegraph lines and the rates of messages will be fixed by the national Government.

SOME merchants of Foochow, China, have raised a sum of 300,000 dols.—say £30,000—for the establishment of an irrigation company. Machinery used in connection with the work has been purchased from the United States.

ELECTRIC HIGH-TENSION ACCIDENTS.

Statistics just published prove that the year 1920 was very bad as regards the number of high-tension electricity accidents in Switzerland. Altogether, 82 such accidents occurred in the year, affecting 90 persons and causing 42 deaths, and this does not include accidents happening on electric railways. The use of electricity having so greatly increased in Switzerland during the past few years, the number of high-tension accidents was bound to increase also; but it is curious that in 1919 there should have been only 53 such accidents (not including electric railway accidents), and on an average between 1911 and 1920 only 51 annually. From 53 in 1919 to 82 in 1920 is a great jump. It may be added that the figures for 1921, so far as they are obtainable, show a marked reduction. The accidents may be classified as follows:—Engineers and technicians, 4 injured, 5 killed; engine fitters, assistant engine fitters and subordinates in electric works, 16 injured, 14 killed; other electric workmen, 4 injured, 2 killed; factory workers, 4 injured 1 killed; men in charge of cranes, 1 injured, 1 killed, and various minor categories. Taking all categories, 48 injured, and 42 killed.

The accidents, classified according to the tensions at which they happened, give the following interesting results:—Persons who came in contact with tensions not exceeding 250 volts, 14 injured, 4 killed; with tensions between 251 and 500 volts, 9 injured, 12 killed; with tensions between 1000 and 5000 volts, 2 injured, 4 killed; with tensions between 5001 and 10,000 volts, 9 injured, 4 killed; with tensions exceeding 10,000 volts, 14 injured, 18 killed. In all save two cases the current was alternating.

EXTENSIVE FRENCH ELECTRICITY DISTRIBUTION PROJECT.

It is reported from Paris that several hydro-electric undertakings have combined for the purpose of establishing an extensive system for the distribution of electricity in the south-east of France and the Massif Central. The companies concerned are the following:—La Compagnie Electrique de la Loire et du Centre, La Compagnie Hydro-Electrique d'Auvergne, La Société des Forces Motrices de la Loire, Les Aciéries et Forges de Firminy, La Société des Forces Motrices de la Truyère, and L'Union Electrique. The combination has taken the name of La Société de Transport d'Energie du Centre. It has its headquarters at 14, Rue du Treuil, Saint Etienne, and it has petitioned the State to grant a concession for a system of electric power transmission linking up the hydro-electric generating stations of the various companies.

The proposed system would consist of the following lines:—(1) The Loire-Auvergne feeder, which is to pass through St. Etienne, Roanne, Gannat, and Commentry; (2) the Cantal-Loire feeder, running from the Brommat Falls on the Truyère, through Saint-Chely d'Apcher, Monistrol d'Allier and Firminy to St. Etienne; (3) the Alps-Loire feeder, passing through Grenoble, Saint Chamond and Saint Etienne; and (4) the Loire-Jura feeder, which is to be laid in the first place from Roanne to Villefranche-sur-Saône. These feeders will be connected with any systems of the same kind which may be created in the neighbouring regions.

The Ministry of Public Works, after considering the project, ordered the opening of investigations as to its public utility. These investigations are now being held in the communes traversed by the projected high-tension lines in the departments of Isère, Ardèche, Cantal, Haute-Loire, Puy-de-Dôme, Allier, Aveyron, Lozère, and Rhône, and the Chambers of Commerce interested have been asked to give their opinion.

If and when the Minister of Public Works shall have definitely approved the scheme, the lines will be executed in two sections; the first will comprise the Loire-Auvergne and Cantal-Loire feeders, to be completed within a maximum period of four years; while the second section will comprise the other feeders and will be completed within ten years. The lines in the first section are to carry 50-cycle three-phase current at a pressure of 120,000 volts or possibly even of 150,000 volts. The minimum transmission capacity of the Cantal-Loire feeder is to be 25,000 kilowatts; of the Loire-Auvergne feeder between St. Etienne and Roanne, 25,000 kilowatts; and of the line between Roanne and Commentry, 15,000 kilowatts.

The new Kazanlik-Tulovo Railway, in Bulgaria, was recently officially opened by the King.

Reinforced Concrete Constructions on Railways.

The best attended meeting in Section I. of the recent Engineering Conference was admittedly that at which Mr. W. W. Grierson read his paper on "The Use of Reinforced Concrete on Railways." On page 58 of our issue of July 15th the paper and discussion thereon were briefly summarised. On the present occasion it is not our purpose to deal with the general use of reinforced concrete on railways, as, for instance, in bridges, buildings, water tanks, platform walls and copings, but to notice its use in smaller constructions, particularly those employed by the signal and telegraph engineer. Among the details mentioned by Mr. Grierson for which reinforced concrete was used were point rodding crank beds, gradient posts, lamp posts, loading gauge posts, mile posts, point rodding roller frames, sign posts, station name boards, station name posts, signal wire wheel beds, boundary posts, cattle pen posts, gate posts and wickets.

There is no need, at this date, to point out in what respects reinforced concrete is superior to wood and steel, especially in foreign countries. Wood, for example, is susceptible to the attack of white ants, and deteriorates rapidly. Steel is expensive, and requires more or less skilled labour for erection and constant painting and

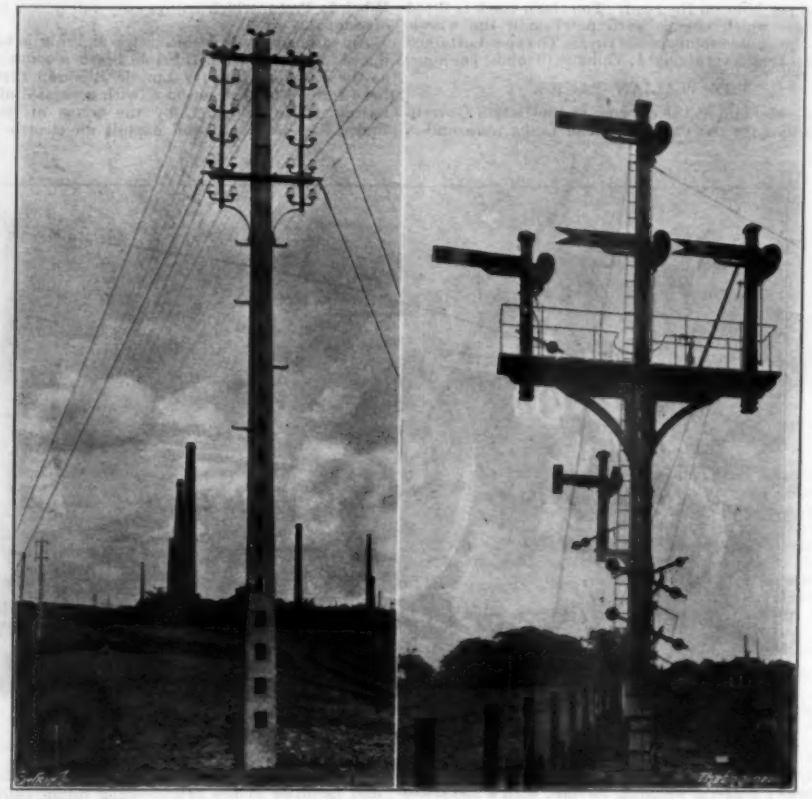


FIG. 1—REINFORCED CONCRETE TELEGRAPH POST

FIG. 2—REINFORCED CONCRETE SIGNAL POST

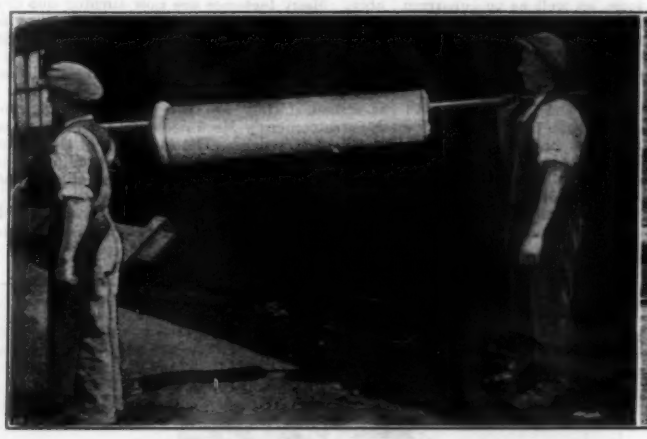


FIG. 3—SECTION OF CIRCULAR REINFORCED CONCRETE TELEGRAPH POST

FIG. 4—SECTIONAL REINFORCED CONCRETE TELEGRAPH POST

FIGS. 5 AND 6—REINFORCED CONCRETE TELEGRAPH POSTS UNDER TEST

maintenance. For signal posts and telegraph poles reinforced concrete withstands storms of wind and snow better than timber and as efficiently as steel. A feature about its use in the smaller details of engineering work, such as those enumerated above, is that such attention has recently been given to their design that they need no longer be three and a-half times the weight of the timber they replace, but only double.

One of the most enthusiastic users of reinforced concrete on railways is Mr. W. Marriott, the engineer, locomotive superintendent and traffic manager of the Midland and Great Northern Joint Railway, as to whom a railway contemporary, when reporting his remarks on Mr. Grierson's paper, observed that "perhaps more would have been done in this country and better reports been forthcoming had other railway engineers the confidence of Mr. Marriott." By Mr. Marriott's courtesy, we are now enabled to publish some illustrations and particulars of signal posts and telegraph poles built to his registered designs and with his patented reinforcements.

In Fig. 1 we show some telegraph poles, with a carrying capacity for twenty-six wires, by the side of a leading English railway. Some of the poles are square and some triangular in section. It will be admitted that the posts are neat in design and of an unexpectedly pleasing appearance; they suggest the power lines of the future. A point made by Mr. Grierson against reinforced concrete telegraph poles was the difficulty of transporting them. As a matter of fact, however, as will be seen from Figs. 3 and 4, those poles which have to be carried some distance can be built up in sections and assembled on the site. The longitudinal rods used for bolting the sections together pass through holes and reinforcement in the precast sections. Poles of the type shown in Figs. 3 and 4 when tested three months after construction gave the results shown in Fig. 9.

At the recent Royal Show at Derby the Concrete Utilities Bureau exhibited some telegraph and power poles, also a bracket signal post carrying four signals—supposed to be one of the largest concrete signals in the world. The latter attracted no little attention, and in Fig. 2 we reproduce a photograph of a similar signal in actual use. From this engraving it will be recognised that none of the features of an ordinary wooden signal are omitted.

Gate posts have already been referred to as suitable subjects for reinforced concrete construction, and an ornamental example is shown in Fig. 7. The upper hinge, it will be seen, can be adjusted vertically. In Fig. 8 is reproduced a photograph of a cruciform-sectional light pole, suitable, among other purposes, for carrying telephone wires in India. This pole, although a very light form of construction, is wonderfully strong. The results of a test of an example, when sixteen months old, are given in Fig. 10. In Figs. 5 and 6 circular and cruciform poles are shown under test.

The licensees for the M.R.C. (Marriott Reinforced Concrete) designs are J. Ellis and Sons, of Leicester, and the sales agent is Mr. W. Jones, 154, Upper Thames-street, E.C. 4.

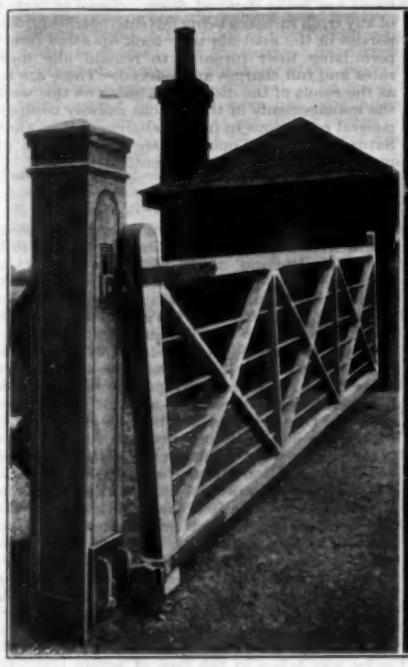


FIG. 7—REINFORCED CONCRETE GATE POST

FIG. 8—LIGHT POST FOR TELEPHONE WIRES

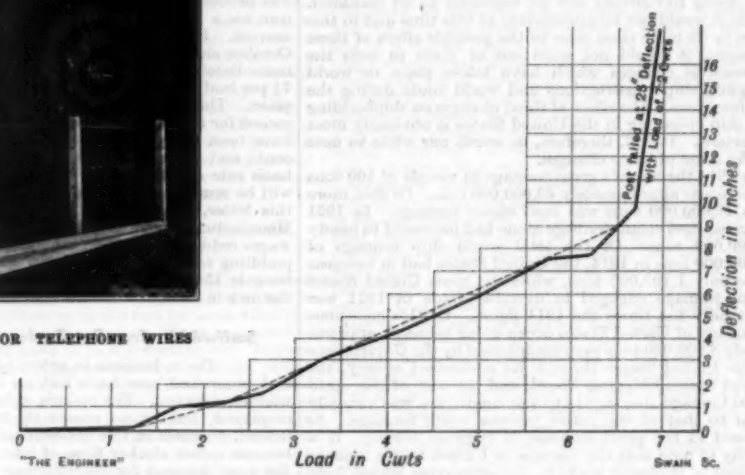


FIG. 10—TEST OF M.R.C. CRUCIFORM POLE.

Date tested, March 29th, 1920; age, 1 year 4 months.

3ft. 9in. firmly fixed in the base and load applied 1½in. above top hole, so that leverage was 15ft. 8½in.

Load. Lb.	Load. Cwt.	Deflection. In.	Remarks.
359	3.2	3	Cracks began to open.
583	5.2	6½	
695	6.2	7¼	Cracks only moderate.
807	7.2	25	Post failed under this load by concrete crushing at base. Tension rods practically undamaged and post sprang back 9in. when load was removed.

Calculated safe load for same leverage .. 134 lb. (1).
Breaking load .. 536 lb. (2).
Load at first crack .. 359 lb. (3).

Factor of safety .. $\frac{(3)}{(1)} = \frac{359}{134} = 2.68.$

Load at failure .. 807 lb. (4) 3600 lb. per sq. in. on concrete. 35 tons per sq. in. on steel.

Factor of safety .. $\frac{(4)}{(1)} = \frac{807}{134} = 6.$

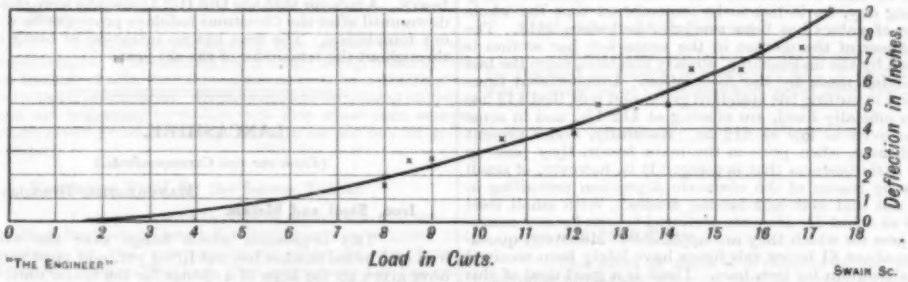


FIG. 9—TEST OF M.R.C. POLE (ROUND SECTION).

Date tested, August 11th, 1920; age, 3 months.

This pole was made in 4ft. tubular lengths, assembled together. Length of pole overall, 24ft. Tested in a horizontal position, 3ft. being firmly fixed in base, load being applied at 18in. from the top; leverage, 17ft. 6in.

Load. Lb.	Load. Cwt.	Deflection. In.	Remarks.
952	8½	2 11/16	First faint tension crack observed 4ft. 9in. above ground.
1176	10½	3½	
1400	12½	5	First tension crack at joint noticed.
1624	14½	6½	Tension cracks not yet serious: pole still considered serviceable.
1960	17½	9	Completely failed at, or about, ground line. No weakness whatever was apparent at any of the junctions of the tubular lengths.

Test load (breaking load) .. 1960 lb.
Calculated safe load .. 344 lb.

Factor of safety, safe load to breaking load .. $\frac{1960}{344} = 5.7$

Load at first faint crack .. 952 lb.

Factor of safety, safe load to first faint crack .. $\frac{952}{344} = 2.76.$

Maximum compressive stress on concrete at failure .. 3420 lb. per sq. in.
Maximum tensional stress on steel at failure .. 26 tons per sq. in.
Safe load calculated for 28 tons steel and 600 lb. per sq. in. safe load on concrete in compression.

THE COMMERCE AND INDUSTRY OF SWITZERLAND IN 1920.

THE report for the year 1920 on the commerce and industry of Switzerland has now been published. This report, which is issued annually by the Committee of the Union Suisse du Commerce et de l'Industrie, which is a combination of the various Swiss Chambers of Commerce This volume, which extends to 470 pages, gives, in the same way as previous volumes have done, a general review of economic life in Switzerland during the year 1920. It contains a fund of information on almost every conceivable subject, and by its aid all interested—and it is especially intended to appeal to the foreign reader—may easily become acquainted with official data regarding the commercial and industrial activities of Switzerland during the period under review. As in former years, the report for 1920 consists of two parts. The first, under the title of "Introduction," gives a general statistical review of the economic conditions of the country; while the other deals in greater detail with the various branches of industry and commerce successively. The purely statistical part, which, by the way, has been very much improved in the present volume, gives in a condensed form a general review of the economic life of Switzerland, and gives particulars concerning such subjects as population, professions, the labour market and salaries, factories, banks, securities, joint stock companies, foreign commerce, customs and public finance. The second part, which contains about forty chapters, first sets out the position, for 1920, of the various commercial and industrial branches, as such. Each chapter begins by giving official statistics of imports and exports for that particular branch. Attention is then paid to such matters as traffic, hotels, banks, securities, commercial and professional instruction, &c. The text of the chapters is accompanied by detailed information as to the production, salaries and prices compared with those of preceding years and pre-war years. Hence the report as a whole, not only gives detailed information as to the commercial relations of Switzerland with other countries, but also as to the economic situation in Switzerland itself. The present report, which, by the way, is published both in French and German, can be obtained from the secretary of the Union Suisse du Commerce et de l'Industrie at Zürich, Switzerland, in return for the payment of 9f. (Swiss) plus postage.

THE Spanish Chamber of Deputies discussed recently the complaints of the coal producers against the use of British coal by the Royal navy instead of Spanish coal. The Marine Minister replied, according to the *Iron and Coal Trades Review*, that an armour-clad vessel consumes 280 tons of Asturian coal in the same time as 135 tons of Cardiff coal. He also explained that the Spanish coal-owners had no floating depôts, and stated that the navy was willing to hand over some old boats for the purpose of conversion into depôts.

Shipbuilding in the United States.

From the annual address of Rear-Admiral W. L. Capps (CC), U.S.N., President, Society of Naval Architects and Marine Engineers, November 17th, 1921.

THERE is nothing abnormal in the comparative confusion and lack of stability in industrial and trade conditions now confronting the world. History is in reality repeating itself. Conditions which prevailed at the end of the Napoleonic Wars, as well as those which have developed at the conclusion of other great conflicts, are being paralleled at the present time, although on a vastly greater scale. Great as has been the industrial upheaval due to the World War, serious as may now appear the conditions which prevail in that industry which is the especial concern of the members of this Society, it is hoped and believed that the return to normal conditions will be much more rapid at this time than at the conclusion of any of the other great world crises.

While it is always difficult for those directly affected to keep in true perspective developments which so vitally concern their interests, there is little doubt that the history now being made in the capital of our country will be epochal in character, and, in the final analysis, the decisions now being formulated will be beneficial to all mankind. While it would not be appropriate at this time and in this place to do more than refer to the possible effect of these decisions, it would not seem out of place to note the tremendous changes which have taken place in world shipping, ship constructions and world trade during the last few years. The effect of those changes on shipbuilding and ship operating in the United States is obviously most important. It will, therefore, be worth our while to note briefly some of these changes.

In 1914 the world's gross tonnage in vessels of 100 tons or more was approximately 49,000,000 tons. Of this, more than 42,000,000 tons was steel steam tonnage. In 1921 the gross steel steam tonnage alone had increased to nearly 55,000,000 tons. Of the total world ship tonnage of 49,000,000 tons in 1914, the United States had in overseas trade only 1,100,000 tons, while the gross United States steam tonnage engaged in overseas trade in 1921 was practically ten times the 1914 figure. Of this enormous expansion of United States ocean-going tonnage, approximately 8,000,000 tons were contributed by the Government of the United States through its authorised agency, the United States Shipping Board, and the cost of this additional tonnage, due largely to war conditions, was virtually equal to that of the entire pre-war world tonnage. As opposed to the great increase in overseas tonnage, it is worthy of note that the increase in United States tonnage engaged in domestic trade in the seven-year period from 1914 to 1921 was comparatively insignificant, being less than 5 per cent. It is also interesting to note that the total increase in world tonnage in the seven-year period preceding and following 1914 was approximately 10,000,000 tons, the percentage increase for the seven-year period 1907–1914 being really greater than that for the seven-year period which included the war expansion.

Nor were the increases in American trade in American bottoms less significant than the increases in American overseas tonnage. The entries and clearances of United States vessels in North American trade had increased from 26,000 000 tons in 1914 to 46,000,000 tons in 1921, while the trans-oceanic or overseas trade had increased from 1,700,000 tons in 1914 to 22,000,000 tons in 1921. The corresponding United States trade carried in foreign bottoms decreased from 31,000,000 tons of entries and clearances in 1914 to 25,000,000 tons in 1921, while the overseas entries and clearances of United States trade in foreign vessels decreased from 48,000,000 tons to 45,000,000 tons in the same period. We thus had, during the seven-year period, 1914 to 1921, a tremendous increase in overseas entries and clearances in United States vessels, with a slight decrease for foreign vessels, the net result being, of course, a very great increase in United States world trade.

In further illustration of the great change which has taken place in recent years in American steam steel tonnage, it is worthy of note that while the increase in this tonnage for the period 1907–1914 was approximately 50 per cent., the increase for the following seven-year period was nearly 300 per cent. Moreover, in 1914 the United States had less than 10 per cent. of the world's steel tonnage; it now has approximately 26 per cent. of the total.

When we note the variations in quantity of steel ship construction for the period in question the facts are even more startling. In 1915 the total tonnage of ocean-going steel vessels of more than 1000 tons gross register constructed in the United States was approximately 112,000 tons. In 1920 this had increased to nearly 2,900,000 tons, or more than 2500 per cent. Now, however, building programmes are nearly completed, and the actual merchant ship steel steam tonnage under construction, as reported by Lloyd's Register for the quarter ending September 30th, 1921, is approximately 420,000 tons for the United States and 4,550,000 tons for the rest of the world.

The foregoing brief references to abnormal changes in conditions with respect to ships built and building and cargoes carried, especially in their relation to the United States, is illustrative of the extraordinary character of the revolution which went on during the seven-year period in question. Of course, no one who has considered carefully the trade economics of the situation has doubted for an instant that serious readjustments must sooner or later take place, and that those readjustments would, temporarily at least, involve many difficulties. Those readjustments are now in the making, and temporary stagnation in United States shipbuilding and a decrease in overseas commerce is inevitable until the abnormal developments due to the war have been placed in their proper relation to normal peace-time conditions.

The membership of this Society is, of course, profoundly interested in the developments which have taken place and are now proceeding. The effect upon the shipbuilding industry as a whole, at the present time, is serious. The effect upon ship operation is also serious. Highly developed shipbuilding plants are, in great part, idle. Hundreds of comparatively new steel vessels are tied up with no immediate prospect of obtaining cargoes. That these conditions are temporary may well be true, and the period of readjustment must be accepted with as much equanimity as possible as a necessary part of the aftermath of the stupendous struggle through which the world has recently passed.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Ironworkers' Wages.

ANOTHER reduction of 7½ per cent. in ironworkers' wages reflects the deterioration of the market during September and October. It was expected that the bi-monthly ascertainment under the Midland Wages Board would show a heavier drop, and in some circles as much as 17½ per cent. was expected. That the decline in the average selling price was no more than enough to carry a 7½ per cent. reduction in wages under the sliding scale was probably due to the relatively active demand for best iron on a total tonnage which was only about half the normal. It is understood the output in September and October showed an increase on that of the two months immediately following the coal strike. A reduction of 7½ per cent. in wages corresponds to a fall of 15s. in selling price. This last reduction goes to make a remarkable record for the year. The successive percentages off wages have been 22½ per cent., 35 per cent., 8 per cent., 5 per cent., and 7½ per cent., reducing the percentage over the basis rate of 13s. 6d. per ton from 265 points to 110. It will be remembered that a short time ago, as reported in this letter, the National Federation of Iron and Steel Manufacturers pointed out that ironworkers had had their wages reduced more than any other class of worker. The puddling rate now becomes 28s. 4d. per ton, whereas the basis is 13s. 6d. The Northern Conciliation Board gives the men in its area a reduction of 10 per cent.

Staffordshire Iron Bar Trade.

The reductions in prices of Staffordshire marked and unmarked bars have had no effect in bringing new business forward. The makers of best bars are fairly well employed, but by no means up to their full capacity; indeed, business in this department of the iron trade has become rather slacker than of late, chiefly on account of the poor demand for shipbuilding purposes. Very little money is being made just now by even the most fortunate of our ironmasters. Many members of the trade are, indeed, incurring heavy losses to-day. It is not to be expected that the descent from the artificial prices of twelve months ago would be anything but a hazardous business. Made in conditions of industrial difficulty which could not be foreseen, the fall has been abrupt and the shock severe. The collapse of values is well illustrated by the Staffordshire marked bar standard. Prices were still at their zenith when this year opened, the standard for marked bars being £33 10s. The reduction of 30s., which was recently announced, is the seventh since the beginning of January, and it carries the price down to £16. But the latter figure equals the highest to which prices soared in the boom which followed the Franco-German War of the 'seventies, and it is nearly double the price ruling when the Great War broke out in 1914. A depreciation of over 50 per cent. in less than a year looks an enormous operation; and so it is, even allowing that there were handsome profits to cut at while waiting for production costs to fall. The subsidence is not over yet, but it is not to be expected that we shall see marked bars at £8 10s. again for many a long day, for it has to be remembered that the whole scale of values has been revolutionised since 1914. The weakness of the market in the unmarked bar section is shown by the underselling, already manifest, since the last reduction made by the Association. Unassociated firms persist in cutting the standard price, and now that £13 has been officially fixed, are offering at £12 15s. and in some cases even as low as £12 5s. Naturally, under present conditions, when price is the main factor, they pick up any little business that is going. It is, however, of small bulk by reason of the obstinate depression prevailing in the nut and bolt and fencing trades. With small steel bars at about £10 they are preferred to iron for any manufactures for which they are applicable. Moreover, quotations about £1 below this figure have lately been received from Belgium for iron bars. There is a good deal of this Belgian material on the market. The galvanised sheet trade continues fairly busy, but the seasonal demand having been satisfied, there is less done in the home trade. Export inquiries are maintained, but competition is keen. Offers are stated to be made at £17 15s. f.o.b. for 24-gauge sheets in bundles, other quotations being £18 and £18 5s., ranging upward to £18 15s.

Business in Pig Iron.

High costs are undoubtedly hampering the production of pig iron in this district, quite apart from the attenuated demand. The local forges are in partial operation only, with the result that there is but a poor call for forge iron. Foundry iron is in a little better demand, and some benefit is expected from the orders which are stated to have been placed at the recent Motor Show. If this develops, foundries will have to replenish supplies. The blast-furnaces are so badly off for work that, although values have fallen, they are ready to make further concessions for an attractive order. Forge iron from Derbyshire is on offer at £4 12s. 6d. and foundry at £5. Northamptonshire irons can be bought at about 5s. under the Derbyshire prices. There is, however, a difference of as much as 5s. between the highest and lowest quotations. Some Northampton iron has been sold as high as £6 5s. delivered. That district appears to benefit from a slight revival of engineering in Manchester. The rapid fall in Midland values appeared to take Cleveland by surprise, Midland smelters underselling that district in the competition for some Scotch business. Trade with Scotland now looks like being recovered by the North-East District, which, as reported last week, has put down its prices 10s. per ton. It is expected this will keep out Midland irons, which have had an advantage of from 5s. to 10s. per ton. Blast-furnaces which are in operation are not able to dispose of their output, and some nervousness exists as to the accumulation of stocks. Two Derbyshire furnaces are being damped down. There is little likelihood of any fresh furnaces being put into operation, and smelters persist in the attitude they took up some time ago as to permitting their furnaces to remain idle until railway rates and full charges are reduced. There are hopes that, as the result of the discussions going on this week between the managements of the various railway companies, some general reductions in freight charges will be announced on Saturday, but the opinion here is that those who expect much will suffer disappointment.

Competition in Steel.

Steel orders are being very keenly competed for, and a well-known Sheffield firm is reported to have been capturing Midland orders at prices substantially below the associated quotation. Constructional engineers are finding more inquiry, but the steel involved seldom exceeds from 50 to 100 tons. There is a general uniformity in plate quotations, but for bars the quotations are differing rather widely. A Sheffield firm is stated to have quoted as low as £9 5s. for 1in. by ¼in. flat, as against £12 quoted by some other firms. Steel makers report more specifications, while a hopeful sign is a certain amount of activity in plant repairs. One firm engaged in the covering of boilers has obtained quite a number of orders for this class of work. Makers here want £8 and upwards for billets and sheet bars. The position of both iron and steel strip is anomalous, but no new declarations have as yet been made. Soft wire rods have fallen 10s., the quotation now being £11 10s. Belgian steel is on offer at prices substantially below home quotations. In almost all kinds of constructional steel the Belgians continue to have the pull. What is believed to be the biggest order for steel windows that has been placed in South America is reported to have fallen to the lot of a Midland firm. The order is for the steel windows for a large post-office building and has been secured by Henry Hope and Sons, Limited, of Birmingham. The order was taken in the face of severe competition from German and American firms, and the Birmingham district thus again demonstrates her ability.

More Work at Coventry.

The Coventry unemployment returns for the last week show decreases, both with regard to the totally workless and to the short-time workers. In the former category there is a reduction of 513 on the week, and of these 280 are men, whilst the return of women workers registered is fewer by 245. It appears that in certain instances the business transacted at the recent Motor Show has begun to materialise, and increased employment is being found in some of the shops, though no permanent improvement generally is anticipated at present.

Trade in the Black Country.

The stagnation which has been seen in the industrial life of the Black Country, particularly in Rowley Regis and Halesowen, for twelve months shows no signs of improving, and the number of unemployed remains at about the same figure as in the early months of the year. In the engineering trades the cancellation of orders owing to the cessation of shipbuilding has caused some firms to suspend a large number of men. The nut and bolt industry has only a few orders, and, generally speaking, the works are employed only a few days a week at most. The chain manufacturers have been able by occasional small contracts to keep a fair percentage of the makers at work on short time, but the list of unemployed in this trade is still heavy. A rumour that the Old Hill Ironworks were closing down until after the Christmas holidays proves to be without foundation. The firm has no intention of being idle throughout the remainder of the old year.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THE depression which hangs over the whole iron and metal market has not lifted yet, and most people have given up the hope of a change for the better until the New Year holidays are over. Why anybody should expect any help from a new year, one cannot say; but the hope is apparently ingrained in human nature, and nothing will eradicate it. The causes of the depression, speaking generally, will not be removed by the advent of 1922, although it is just possible that one or two hindrances to revival may be out of the way. There are, however, scores of impediments to trade yet remaining. The removal of restrictions on trade—not in Great Britain only, but in all European countries—and the re-establishment of cheap transport in this country are two of the preliminaries wanted, and at present one sees no probability of getting them.

Metals.

It is something to be able to say that the general condition of the non-ferrous metal market is no worse than it was. There is reason to believe that the absolute bottom of the market has been reached in the matter of standard and refined copper. Looking back, one finds that the standard copper market has remained practically steady for about three months, and that should be long enough to re-establish confidence. It is probably not for want of confidence that consumers of copper do not buy more freely, but from want of use for the metal. The copper market is thus ready for an advance in prices so soon as general trade revives. It may be described as waiting on a rock bottom for the return of the tide. It is pointed out that a very considerable tonnage of standard copper is coming on the market as a result of the conversion of

scrap, and some people think that this may depress the market; but it has to be remembered that this scrap pressed more heavily on the market before measures were taken to convert it into standard, and so far as the brass scrap was concerned there has been a great waste of metal in the process, so that one cannot see how the prospects of the market can be injured. The weakness of the consumptive market for copper must, of course, still exist, or otherwise the price of best select ingot could not keep so near to standard prices. The price of electrolytic copper remains about as it was; but the gradual improvement in the American Exchange ought to tend to lessen the difference between electro and best select. The prices for manufactured copper and brass have not been altered, and the charges for manufacturing are still as excessive as ever. One excuse for this is that producers cannot find a market for all that they could turn out, and hence overhead charges are very heavy; but economically speaking this is a very bad excuse. The market for tin has maintained its strength fairly well, and although there is still quite a large supply of the metal, it has ceased to increase, and there is a good chance of more favourable statistical features in the New Year. Continental buying has been fairly good, and the tin-plate trade in South Wales is taking more metal. America has also been buying tin. The rise so far seems to have been the result of trade and not of speculation, and if speculators will keep out, the upward movement will probably be slow, but steady; and that is much safer than a rapid boom in prices. Lead has been a very strong market, although there has been a slight set-back from the highest prices reached. It is thought that the recent sharp movement was caused by the coming in of consumers who had been waiting for a fall, and who had grown tired and a little nervous. Germany has been buying again, but she is now getting a large proportion of her supplies direct from Spain, which accounts for the smaller shipments of Spanish lead to this country. Spelter has been a comparatively quiet market, but it has responded slightly to the advance in lead.

Pig Iron.

The market here for all kinds of pig iron remains very quiet. Buyers seem to take no interest, and sellers feel that they have already gone as far as possible, and perhaps farther than is wise, in the way of reducing prices. It is, in fact, now almost certain that no concession in price would attract business; and if only retail lots can be sold it is just as well to get retail prices for them. What will happen when more active business is resumed next year one cannot say; all that it is possible to say is that consumers are convinced that they have nothing to lose by waiting, and while this opinion prevails, one cannot expect to see any active buying. The lowest price heard of for foundry iron delivered here has been £5 per ton, and this is nearly £1 below the cost of Cleveland iron, carriage paid to Manchester. It seems, however, to be expected that this Cleveland railway rate will be reduced next year, in order if possible to get back some of the important railway traffic between Cleveland and Manchester. The demand for forge pig iron is, if anything, smaller than that for foundry, and the reduction of the Cleveland price to 90s. per ton produces no effect, unless it be to make people say that if forge pig can be sold at 90s., there is no excuse for asking 100s. for foundry!

Finished Material.

The nominal prices for finished iron and steel here remain as they were; but there are reports that much lower prices for finished steel have been accepted on the East Coast, presumably for export. The British consumer certainly does not like to know that manufacturers are charging him 30s. or 40s. per ton more for steel than they are charging to the foreigner; and reports of this kind confirm the idea that less might be asked from the home buyer.

Scrap.

The market for scrap is now almost dead in all departments. The demand for foundry scrap has lingered on longest of all; but this seems now to be dwindling to very small proportions. Dealers seem to be getting anxious and are beginning to realise that they must soon accept much lower prices, certainly down to £4 per ton for good scrap.

Ventilating Plant for the Severn Tunnel.

I am pleased to be able to report that the firm of Walker Brothers (Wigan), Limited, has been awarded the contract for the new ventilating plant for the Severn Tunnel. Walker Brothers were responsible for the construction of the original plant required during the driving of the Tunnel, and subsequently for the permanent plant which was installed when the undertaking was completed and opened for traffic some thirty-four years ago. After having been in continuous operation during the whole of this time, the Great Western Railway Company's chief engineer has decided to replace the existing plant by a larger one in order to cope with the enormously increased traffic which now passes through the Tunnel. The new ventilating plant will have a capacity of 800,000 cubic feet of air per minute. The fan will be of the "Indestructible" type, and it will be driven by a single tandem compound condensing engine, with several features of interest, one of which is the valve gear. The valves will be placed in the cylinder heads, thus giving facility for jacketting the steam valves with live steam and reducing the clearance to a minimum. The plant will also include boilers, which will be of the Lancashire type, with a working steam pressure of 150 lb. per square inch. The boilers will be provided with superheaters and economisers. It is estimated that when this plant is in full operation it will be possible to change the air in the tunnel about every fifteen minutes.

The Outlook in the Textile Industries.

Although things are pretty gloomy at present in connection with the cotton trade, men who are capable of estimating the position as closely as possible consider that the worst has been passed. Mr. Alfred Watkin, chairman of that great Manchester undertaking, Lloyd's Packing Warehouses, in his annual review agrees with this statement, although he discourages any idea that the return to normal trading conditions will come quickly. With regard to the condition of trade during the year just closing, Mr. Watkin said that things could hardly have been worse. Depreciation in the value of stocks and unprofitable working have brought about disastrous balance sheets, and where devidends had been paid they had only been made possible by dipping into reserve funds or by the refunding of excess profit duty, or both. He stated that cotton spinning and manufacturing and the allied industries, such as bleaching, dyeing and printing, had been compelled to adopt short time, and that in spite of shorter working hours, more machinery had been actually stopped or running intermittently than in any year within living memory. He added that no industrial community in the world could now afford strikes, and least of all the people of this country, the population of which was three times as large as could be fed from our own internal resources. Export trade was more essential to the people of these islands than to any nation, and we should have to stand or fall by our power to export at a competitive price.

Scheme for a New Arterial Road.

Arising out of the problem of finding work for the unemployed in Lancashire, there has recently been discussed a scheme for the construction of a new trunk road between Manchester and Liverpool to accommodate the great amount of road traffic which now passes backwards and forwards between these two great centres of industry. The idea is for a road 120ft. wide, running parallel with the Manchester and Liverpool railway, instead of deviating as the present road does by way of Warrington and Prescot. The proposal originated from a letter from the Town Clerk of Salford to Sir Montague Barlow, in which the suggestion was made that the local authorities involved should call a meeting in conjunction with the Ministry of Transport to consider the matter. The cost of the road is estimated at £4,000,000.

BARROW-IN-FURNESS, Thursday.

Hematites.

The demand for hematite pig iron is very small indeed; but little business is being done, and the prospects are that this will continue to be the fact for some time yet. It is recognised all round that before things can come at all normal, prices will have to be still further cut. Buyers, on their part, will not place contracts at existing prices, having in mind the competition they have to face, and smelters are held up by reason of the fact that the cost of raw materials, particularly coal and coke, remain high and railway rates are very heavy, the recent concessions in the carriage on iron ore and limestone being only small, owing to the close proximity of the mines and quarries to the furnaces. There are only seven furnaces in operation in the entire district.

Iron Ore.

The demand for iron ore has eased down, and it is possible that before the end of the year the call for ore may be further lessened. On Saturday last the Hodbarrow mines in South Cumberland closed down until further notice, and the mines of North Lancashire, those that are engaged, are working short time. A cargo of ore arrived in Barrow last week from Les Falaises.

Steel.

There are no new features to report in the steel trade. Rails continue to occupy the bulk of the attention at Barrow and Workington, and some of the smaller departments are engaged, including the Barrow Hoop Mills and the foundries. Business is quiet all round, and it is not at all certain how long the present activity, such as it is, will last.

Shipbuilding and Engineering.

These trades are badly in want of new orders, but the demand at present is absolutely nil. A long holiday will be observed at Christmas and in the New Year.

SHEFFIELD.

(From our own Correspondent.)

Iron and Steel Prices.

THE price at which it is possible to buy pig iron and steel billets has fallen so very appreciably that many makers must be selling at a considerable loss on the basis of prevailing costs of production. Such quotations, however, are generally for forward business and represent makers' faith in an almost immediate further reduction in raw material prices and in wages, to say nothing of alleviation in the matter of railway rates. On the other hand, consumers seem quite disinclined to venture very far ahead in their commitments, as they are not at all convinced that the bottom of the market has been touched. Perhaps they are right, though makers contend that values have now gone almost as low as they will do, and that the great probability is that with prices rising on the Continent the same tendency may manifest itself on this side of the Channel before very long. Foundry pig iron of a quality far superior to anything imported can be picked up now for something less than 100s. at the furnaces, and soft basic billets have been sold as low as 150s., which is within about 40s. of the cheap pre-war days for the home article, when Belgian billets were offered f.o.b. Liverpool or Hull at about 90s. One of the most hopeful features of the situation continues to be the manner in which production costs everywhere are being deflated. The sliding scale is operating in that direction in the matter of the wages of many of the iron and steel workers; coal prices are on the fall; railways are being pressed to reduce their rates for minerals and metals; case-hardening steel is said to be cheaper—a very helpful factor now that a sort of revival has come into the motor building industry—and rolling mill charges have been reduced. Wire rods have been further lowered in price, but consumers complain that they are still too dear to assist wire rope makers in their fight against foreign competition. In fact, these makers, who went in for important expansion of output during the war, are now suffering severely from the need of sufficient orders to keep more than a comparatively small proportion of their capacity employed.

Bad Trade and Good.

Taken on the whole, it cannot be said that the past week has yielded many grains of comfort regarding the trade situation, which remains very much in the same position as when last reported on. Most people seem to have written the remaining weeks of the old year off as a bad debt and are looking forward to better things in 1922, whilst there are some who profess to have no faith in a trade recovery before next autumn. Such a view sounds horribly pessimistic, though experience teaches one the folly of discounting an opinion of the kind too readily. I remember well enough that twelve months ago almost precisely similar views were expressed by certain leading industrialists. Everybody thought them extreme and unlikely at the time, but we know to-day that they erred only in their moderation. At the same time there certainly appears to be a gradually strengthening undercurrent of returning trade, and what I have mentioned in previous letters continues to be the case—one is often hearing of quite good business booked by firms here and there. Only this week an instance was brought to my knowledge in which a firm has some big orders in hand for steel rods, and it is known that a good deal of activity prevails in heavy steel departments—apart, of course, from armament work, which is at present in a state of suspension, except for contracts in execution for, say, Japan. In the aggregate a good deal of work is in operation for the construction of hydraulic presses, both for the home and overseas markets, rolling mills and Lancashire boilers, and it is believed in many quarters that with the turn of the year will come a considerable amount of business—now being deliberately held up—for crucible and other high-grade steels, as well as for engineers' tools. As a general thing makers of tool steel continue very quiet, and high-speed steel manufacturers are waiting until the market has been cleared a little more of the surplus stocks thrown on to it by the Government, to which reference was made in a recent letter. One of the arguments employed against the purchase of these surplus stocks is that consumers will find a good deal of rubbish amongst them. Is not such a contention, however, a little curious? Was any part of the Government's high-speed steel requirements satisfied from abroad during the war? If not, without in the least bit lowering my very high estimation of the home makers of this special crucible steel, I would like to ask: Whence came this high-speed steel which now contains so much "rubbish"? I know that during the height of the war—or the depths, whichever way one views the matter—when quality interfered with speed, the latter became of chief importance; but "C3" material in the stress of war time might have proved very serious indeed. What is most likely, however, is that the quality was not appreciably lowered in favour of bigger outputs and that the high-speed steel surpluses now on the market are, on the whole, what they seem to be.

Machine-made Cutlery.

On the other hand, there is no doubt whatever that in some directions quality was sacrificed to speed of production, and that thereby many skilled workmen lost the preciseness of detail that had helped to build up a great reputation for Sheffield's goods. Such, for instance, was certainly the case regarding cutlery manufacture. The war found that industry very poorly equipped indeed for rapid production by machinery on mass lines, and as the multiplication of output, without delay, was of vital importance, the hand workers—forgers and grinders particularly—flung their customary punctiliousness to the four winds and went in for speed and high wages. The result was the cultivation of slipshod methods, with which they have since found it extremely difficult to break. During the war, however, forging and grinding machinery was introduced on a remarkably extensive scale, the advantages of it were recognised, and to-day the very trouble referred to is being eliminated in part by the efforts of the most skilled and careful craftsmen, but in the main by the adoption of entirely new methods of production by machinery designed by engineers. I have compared some of the hand-forged and ground table blades with those produced entirely by machinery, operated, in one special instance, by ex-Service men, most of them disabled by the loss of a limb, and I am bound to say it was not to the advantage of the former, though Alderman W. F. Wardley, the Deputy Lord Mayor of Sheffield, and himself an old cutler, has just expressed his unqualified conviction that nothing could possibly beat the old-fashioned hand-forged blade. I admire and respect Mr. Wardley, who is absolutely "one of the best" among real Sheffielders; but I would like to add that whilst what he says may be true, it is also the fact that the conditions under which many of those "old-fashioned hand-forged blades" are made could scarcely be exceeded for abject wretchedness and peril to health. It is still true that 50 per cent. of the cutlery grinders of Sheffield succumb sooner or later to the scourge of consumption. Such knowledge seems to rob the hand-forged and hand-ground blade of much of its glory and to make one greatly desire the coming of the day when machinery will be the only means by which cutlery and edge tools of all kinds are produced. Indeed, that day is not far off.

The Trade Technical Society Movement.

Speaking of cutlery and edge tools reminds me of a very notable addition which is this day—Friday—being made to the trade technical society movement in Sheffield. In previous letters I have explained that the movement was launched two or three years ago, on the initiative of Professor Ripper, Dean of the Faculty of Engineering at the Sheffield University and head of the Applied Science Department there, the first society to be formed being that for the cutlery industry. Then followed the silver and electro-plating trade, the file trade, and the edge tool industry, which were all kept in touch with one another by means of a joint council. To-day, in the Mappin Hall

of the University, the Rolling Mills and Forging Trades Technical Society is to be inaugurated, and this, too, will become affiliated to the other four societies. Lectures are given regularly during the session, and the attendances and discussions amply prove not only the need of such a movement, but the manner in which its usefulness is understood and appreciated. At these gatherings one can see an employer and the least of his employees sitting side by side and participating in the discussions. The movement is no respecter of persons, the only qualification for membership being an earnest desire to assist in the uplift of the industry as a whole, which, of course, means to the individual a tremendous advantage. The trade technical society is very little removed from the research association, a fact that has just been emphasised by an agreement reached by the British Cutlery Research Association to accept skilled representatives from the Cutlery Trade Technical Society on each of the Association's sub-committees.

Gas for Furnaces and Engines.

Just recently I mentioned an outcry raised by some of the manufacturers here who use considerable quantities of gas regarding the high cost of operating gas furnaces and engines with the gas company's charges as high as they now are. Another definite instance can be given. It may possibly be recalled that during the war I mentioned in one of my letters a visit to a rolling mills at Wadsley Bridge, in one of the suburbs of Sheffield, where I saw women rolling hollow steel round bars by the firm's special process, the bars being required in the manufacture of rock drilling tools, which allow sprays of water to be operated whilst the tool is being worked. I had never seen women at work in a rolling mill before, but there was nothing in the least bit degrading in the spectacle. They took to the work in a most natural manner and with excellent results. That, however, is quite apart from the matter about which I was going to speak. The managing director of these mills, which form part of a small combination of steel concerns presided over by one of the most prominent men in the North, says :—"Our gas is costing us more than six times the price of 1914. In that year we could produce a ton of steel at 2s. 10d.; to-day the same material, produced in exactly the same way, costs us 17s. 6d. per ton. What is the result? I cannot afford to pay to-day's gas prices, and I am just completing a new mill which I have arranged to drive by electricity because of the high cost of gas. The gas engines which work our rolling mills—and this is a standard Sheffield business—are so costly that we cannot run them. The price of gas is enormously up and the quality is down, and until we have some change gas cannot be used in furnaces and in many other ways in which it has been adopted in industry." When a fall in production costs is being demanded on all sides and coal for industrial purposes has dropped in value, to say nothing of the schemes now in existence for the utilisation of coke oven gas, it begins to look as if it was high time the gas undertaking seriously took into consideration a further reduction in the rate per therm. These are critical days, and nothing that could possibly assist in the restoration of trade and commerce should be neglected. Readjustments could come later when the situation was assured.

The Problem of Coal Prices.

During the past month or so some very substantial reductions have taken place in large steam coal, cobbles and nuts. The comparatively small demand for inland consumption has resulted in a great deal of competition for business, and at pits where the management has desired to work full time, in order to reduce the cost per hour of production as much as possible, prices have been cut in a wholesale manner. The Sheffield quotations given in the "Current Prices" column are approximately the middle figures for inland sales. At the present time there are some very wide margins in quotations for similar quality fuels, it being no uncommon thing for collieries to be selling one quality of coal at a difference of 8s. per ton, as between the highest and lowest prices, while in some few instances the difference is even wider than that. Generally speaking, prices for export *vid* the Humber ports are substantially lower than those obtainable for inland sales. This is owing to the fact that competition from the Tyne is so strong, and the higher rates to ports severely handicap collieries in obtaining business. Indeed, it would simply be impossible to do so at the prices obtained inland. There has been a considerable amount of comment in regard to this, and, in effect, manufacturers say to collieries: "You are willing to sell coal to foreign manufacturers at much lower prices than to us, thus enabling them successfully to compete against us in other markets. Why not supply us at the same pit prices as you are taking for export?" This question opens up a very wide problem, but there is no real relationship between inland and export pithead prices. It simply is a question of supply, demand, and competition between one coal-producing area and another, as well, of course, as with other coal-producing countries. Incidentally it may be mentioned that when inland prices were controlled manufacturers had a very great advantage in pit prices as compared with those that were obtainable for export. At times the difference was as much as 40s. per ton.

The October Ascertainment.

One can understand the anxiety of manufacturers to buy fuel at the lowest possible prices at the present time, and with the competition in evidence, and daily becoming keener, prices will settle down, so that in all probability it will not be long before inland and export prices are practically at the same levels. It had been expected that on the results of the "ascertainment" for October there would have been a further substantial wage reduction this month, and there is no doubt that in some cases prices have been reduced in anticipation of one. As a matter of fact, however, the reduction is such a fractional one that it is doubtful if the costs of production will be affected more than a fraction of a penny per ton. Under these conditions it is quite possible there will be a far more cautious policy adopted regarding prices, as most collieries are losing somewhat heavily, and it is a suicidal policy to force sales at prices far below cost of production.

NORTH OF ENGLAND.

(From our own Correspondent.)

Export Trade Reviving.

Although the general industrial position in the North of England still gives considerable room for improvement, there are good grounds for belief that the corner of depression has been turned, and that trade is gradually reviving. This view is strengthened by the returns of the export trade in Cleveland iron and steel for the month of November, and also a welcome falling off in the imports from abroad. It is most encouraging and no less surprising to find that the aggregate exports of pig iron, manufactured iron and steel for the month of November are the best recorded for any month since September, 1920, and inasmuch as manufactured steel and iron requires more labour expended upon it, the fact that the improvement in trade is largely due to the upward leap in finished iron and steel exports should be a source of special satisfaction. Since August there has been a substantial improvement monthly in the exports from the Cleveland area, and this is revealed by the following totals:—August, 28,213 tons; September, 43,839 tons; October, 53,818 tons; and November, 61,237 tons. At present there are twenty blast-furnaces in operation—nine on hematite, six on basic, three on Cleveland, and two on special iron—but four more hematite furnaces are to be re-started, making twenty-four operating on the North-East Coast, which is just about one-third of the normal. There are, however, hopes of an early increase in the pig iron export trade. It is curious to note that, notwithstanding the recent big imports of French, Belgian and German iron, each of those countries takes a certain quantity of Cleveland iron every month. Last month, for example, 801 tons went to France, 945 tons to Belgium, and a small parcel of 25 tons to Germany.

The Exports of Finished Material.

The exports of manufactured iron and steel from the Cleveland district in November totalled 48,407 tons, as compared with 36,859 tons in October, and 36,279 tons in September. The improvement was entirely due to enormous shipments to India and Ceylon. A total of 24,859 tons to those countries has never been equalled or even approached since May, 1914, and even in pre-war days such figures would have been regarded as highly satisfactory. The total quantity of 5212 tons shipped in November to Australia and New Zealand is also the year's best, whilst the maintenance of the substantial trade which has been opened up with the Argentine and, to a smaller extent, with Uruguay, is also an indication of the penetration of British trade.

Reduced Imports.

During the month there was a substantial falling off in the imports of iron and steel to the Cleveland district from Belgium, France, Sweden, and Germany. The grand total only reached 17,368 tons, as against 20,509 tons in October. The imports of billets, blooms and slabs in November were 4760 tons, as compared with 6945 tons in the previous month. In the same period the unloadings of plates, bars, rails, joists, and sheets from the countries named were as low as 236 tons, whereas the amount in October was 781 tons.

Cleveland Iron Trade.

A much better inquiry is reported for Cleveland pig iron, although the business actually transacted still continues within narrow limits. There is no doubt, however, that the imminence of the Christmas holidays and the annual stock-taking period has largely counteracted any beneficial effect which the recent price cuts might otherwise have effected upon the flow of orders. Foreign competition is not so keen, but even at the present prices makers are handicapped in meeting it. The greatest handicap, however, is as regards railway rates. It costs, for example, nearly £1 per ton to get Cleveland iron to consumers' works in Scotland, and to that extent—or almost to that extent—we are undersold by the foreigner. The moral is obvious. Railway rates will have to fall, but Cleveland prices will also have to fall further before trade is fully restored.

Hematite Pig Iron.

The output of East Coast hematite pig iron is being increased by the re-starting of four more furnaces and competition for orders, already keen, is certain to increase. Indeed, unless the demand improves, a good deal of iron will have to go into stock, although South Wales still supports local industry by taking considerable quantities of hematite. The price tends steadily downward, and mixed numbers can now be obtained at 105s., though 110s. is still asked for small lots, with No. 1 at a premium of 2s. 6d.

Iron-making Materials.

The foreign ore trade remains in a lifeless condition. Consumers have large stocks, and in the present state of industry are not inclined to place new orders. In spite of the absence of demand, however, prices continue firm, and best Rubio ore is quoted 27s. to 27s. 6d. per ton c.i.f. Coke is no weaker, but 30s. per ton delivered is now a full price for good medium furnace qualities, and for a long contract business is reported as low as 25s. per ton delivered.

Manufactured Iron and Steel.

The position in the manufactured iron and steel trade shows little alteration on the week. The market is still quiet; orders are for quite trifling quantities, and the multiplicity of specifications for small orders all adds to the cost of production and makes it still more difficult for manufacturers to make the price cuts which are necessary to capture orders. They are, however, making big sacrifices to get business, and mean to get orders if it is humanly possible to do so. Prices are unchanged, except that galvanised sheets have fallen to about £17 10s.

The Coal Trade.

The northern coal trade has taken on a new lease of life. Matters have not been so brisk for many a long day. The Northumberland steam coal section is very active, with a good inquiry for every class for the whole of December, while in the case of best screened sorts supplies are so scarce as to be unprocurable from the pits direct, while even through second hands the quantities are limited and only to be had at inflated prices. Business in steams for next year is still under discussion in a number of cases, and in odd cases contracts are being entered into with delivery over either the first half or the whole of the year at much lower prices than those at present ruling. One transaction reported to have been made was for 1500 tons to about 2000 tons of unscreened Northumberland steams per month for the whole of next year at 16s. 6d. free on rail, for inland trade, and the class purchased was Howards or similar. There is, however, considerable controversy with reference to the contracts placed for next year, and while many of the usual exporters, and some of the collieries, are of the opinion that they have been done too cheaply, others are firmly convinced that they are only the beginning of many more such deals at possibly lower figures. Time, however, will establish the facts one way or the other, and in the meantime the majority of buyers are inclined to adopt a cautious policy. The Durham market is not quite so satisfactorily placed as the sister country, although there is certainly an improvement upon recent experiences, and there is not quite so much lost time at the pits as formerly. Gas coals are being taken out in greater volume both for inland trade and also for shipment, which is largely repeated for both bunkers and coking, but any business under consideration is nearly always for prompt. Not many contracts for next year's delivery or shipment are being transacted, from which it may be inferred that there is as yet no assurance of stabilisation of prices, which would encourage forward bookings. The gas coke trade is very brisk and prices on the firm side. The output is rapidly cleared, as there are no stocks in hand worth mentioning. Foundry coke, though a shade better, is still generally weak and nominal.

New Tees Foundry Project.

A big scheme of extensions is in contemplation by the Tees-side Bridge and Engineering Works, Limited, Cargo Fleet, Middlesbrough, and a large area of land adjoining the works is to be purchased from the Middlesbrough Corporation. The firm has been successful in securing a large order for material which has previously been manufactured in India by native labour. It is proposed to build another foundry on this land so that the firm can permanently continue the manufacture of the new speciality, and, as soon as the local steel trade revives, it is intended to re-start work in No. 1 foundry. The scheme will enable the firm to take more orders immediately and to find work for a large number of additional men.

SCOTLAND.

(From our own Correspondent.)

Improving Outlook.

So far as regards actual business, general conditions show little change, but there is a growing feeling that the worst is past and that an improvement in industrial circles is now within measurable distance. Though little more than a ripple on the surface, some movement is already noticeable, and with the turn of the year many look for better things. Fuel, raw materials, and wages have dropped considerably and a competitive basis of prices is looming nearer and rumours of business being held up are occasionally heard. Inquiries from abroad are more prolific, and, given a more stable basis of finance, transactions are almost assured. Freights, in most directions, are cheapening, and if this movement continues until the end of the month there is a certain amount of reason to assume that consumers will show considerably more activity than has been witnessed for a long time back. Already in some departments of industry prices far below open quotations are being accepted, and there seems room to believe that, given business in sufficient bulk, something close on pre-war standards of charges might be established in some, though not in all, directions.

Small Shipbuilding Output.

In the shipbuilding trade things are just about as quiet meantime as they could possibly be. Steamers are being launched and empty berths increase at a similar ratio. Almost nothing in the way of new contracts is reported. The last instalment in the wages reduction at the yards falls due just after the beginning of the new year, and until that takes place and other costs stabilised accordingly there seems little reason to hope for new merchant work. Few vessels were launched on the Clyde during November. The aggregate figures are seven vessels of 15,850 tons, which is the lowest for this year, with the exception of the month of January. Chief amongst the launches was the Davanger, oil tank steamer, 7150 tons, for Messrs. Westfal-Larsen and Co., Bergen. Of the other six, one was of 3600 tons and the others under 2000 tons. Messrs. Yarrow's yard at Scotstoun, which was to have closed down on November 30th, will not suspend operations until the end of this month. The delay is owing to the fact that the work in hand when the suspension notice was posted in August last has not yet been completed.

Pig Iron.

Scotch pig iron makers are having a very trying experience. Only some eighteen furnaces are working, but the production is not all being absorbed. Business is evidently not to be had. Quotations are falling with fair regularity, but the quietness in the steel and iron trades is reflected in the demand for pig iron for home consumption. Export, also, is of meagre dimensions, and the transactions concluded afford little relief to merchants.

Steel and Iron.

The scarcity of business in the steel and iron trades is everywhere apparent, and works have a difficult task to preserve even a minimum degree of employment. Makers, apparently, are quite prepared to forego the bulk, if not all, of the profits in order to keep things going, and consider themselves fortunate to secure any business that will pay expenses. Costs are still falling, however, and there is reason to believe that makers will soon be in a position to quote a price in keeping with consumers' ideas. In any case buyers are evidently determined to await such conditions. It is said that on occasion prices similar to pre-war values have been accepted, but strict confirmation is not forthcoming. Meantime steel plates are very quiet, and sheets of all descriptions are practically in a similar position. Structural steel is in more request at present. Consignments of English steel have been more in evidence lately. While bar iron mills still run slowly inquiries indicate better things and the outlook is more promising. A fair turnover is being done in machine tools. Steel and iron tubes have fair orders on hand for the home trade. Export all round is dull. The tendency of prices is easier on the whole and further reductions are anticipated before the turn of the year. Consumers in the Far East have been more active recently, and with freights easing signs in this direction are hopeful.

Coal.

The Scotch coal trade on the whole moves on recent lines. In the West of Scotland the home market is quiet in the extreme, apart from house coal, owing to the great scarcity of industrial orders. A quiet turnover is being done with gas and electricity works and railways, these concerns buying for immediate requirements owing to the constant depreciation in prices. In some sorts export is fairly good, though during the past week steamers have been delayed by heavy weather. West of Scotland collieries have good orders for ell and splint coals, and treble nuts are a little more active. Lothian steams are fairly well booked, and Fifeshire merchants are doing a quiet business in treble, double, and single nuts. In a report on the wages question issued by the accountants the wages of Scottish miners will be reduced presently by 2¼d. per day.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

OPERATIONS in the steam coal trade can scarcely be described as having been quite so active during the past week as had been experienced during the previous fortnight or more; but the probability is that, seeing that the present month is a short one, exporters have arranged for their requirements earlier than is usual in the expectation that there might be a certain amount of pressure just before the holidays, and that, with the working of collieries a trifle uncertain it was deemed better that they should book up their supplies rather than run the risk of not being able to get them at all. Furthermore, at the prices ruling and the outputs which are being obtained many collieries cannot possibly make both ends meet, and in addition to notices having expired at several pits, owners have given fourteen days' notices to terminate contracts at other undertakings, and from all accounts they do not intend to re-start work until the times are better and they can see an improved prospect of running the mines without making a severe loss. This uncertainty as to whether individual collieries will be working makes it very difficult for business, for although prices have fallen very substantially, it cannot yet be said that South Wales coals are on a proper competitive footing either as regards the northern districts of the United Kingdom or foreign coals. In Spain exporters are up against native coals, and so far as Italy is concerned advices show that the Americans are still endeavouring to maintain their hold on that market by sending cargoes to Italian ports and selling them for the best prices they can obtain. Against such tactics as these it is naturally very difficult for local exporters to compete. Still, the position in this district might be very much worse. As a matter of fact, collieries are very well stemmed for this month and salesmen are not compelled to make the reductions to obtain orders that was the case a few weeks ago.

Miners' Wages.

As was fully expected, there has been a further fall in the wage rate for miners for the current month. The audit of the accounts for October showed results more unsatisfactory than for any period since the national settlement. The owners' wage liability for that month was 79.03 per cent., and the audit showed that there was a loss in addition to that sustained in September of £450,000. The certificate of the auditors disclosed that the percentage payable to the workmen for the month of December will be 28.03 above the 1915 standard base rates. So far as the lower-paid day wage men are concerned nothing definite has yet been arrived at. The owners' offer of a subsistence allowance which would bring their wages up to a minimum of 7s. 2d. per day was hedged about by conditions which the men's leaders were not prepared to accept, and therefore they decided to submit the whole position to the delegate conference, which was held at Cardiff last Saturday. The two clauses which were objected to were that the allowances should not apply to single men, and that men absenting themselves from work should not be entitled to benefit. The conference gave the matter its attention, but its decision was that it should be left to the lodges to say whether the owners' proposals should be accepted or rejected. The lodges were instructed to send in their decisions by Thursday, the 8th inst.

Dock Workmen's Strike.

Since writing a week ago there have been developments in the situation as between the shipowners and the dock pilots, boatmen and riggers, although in all the circumstances the difficulties created by the latter have been overcome with surprisingly little inconvenience. Men engaged on tugboats adopted the policy of only working those vessels, the masters of which agreed to pay the tariff demanded by the dock pilots, boatmen and riggers. The result was that the owners of the tugboats dispensed with the services of their crews. Following on this, the dock pilots, boatmen and riggers decided to withdraw their labour altogether, and they refused to work on any ships on any conditions as from Saturday morning last. From all accounts, however, the men are not very wholehearted about the affair, although the more extreme of them imagine that the dispute will be brought to a head all the sooner by these tactics. The shipowners are facing the position with equanimity, and already have one tugboat and are arranging for two others with which to assist the movement of ships. Of course, a certain amount of inconvenience is being caused to shipping, but owners are putting up with that. The strikers are not feeling at all easy about their position, and apparently are hoping for a spell of bad weather in order to create difficulties for shipping and make the owners adopt a more ready policy to meet them and settle the dispute on lines more favourable to the workmen.

Copper Workers' Wages.

At the end of last week a settlement was arrived at concerning the wages of Swansea and district copper workers. Several meetings had been held, mainly regarding revised rates, and the employers in their amended claims endeavoured to bring about a 20 per cent. reduction in wages and the fixing of the age limit from eighteen to twenty-one. It was decided, however, upon an all-round reduction of 12½ per cent., and the age limit question was referred to a committee.

Steel and Tin-plate Trades.

The conditions of employment in the Llanelly district are now much improved, and it is reported that practically all the steel and tin-plate works are in operation. Messrs. Richard Thomas and Co. re-started the mills on Monday at their Burry Extension Works, which have been at a standstill for close on nine months, and additional mills were expected to resume this week at the Western Tin-plate Works.

Loss to Coal Trade.

The South Wales coal trade has sustained a severe loss by the sudden death of Mr. Hugh Bramwell, who was the general manager and a director of the Great Western Collieries, Limited. Mr. Bramwell was sixty-two years of age and a native of Tynemouth, being the son of Dr. John Byron Bramwell. He was educated at Cheltenham College, Edinburgh University, and at the College of Physical Science, Newcastle-on-Tyne. After being articled to the late Mr. John Dalglish he served as under-manager at the Marsden Colliery, Durham, and after being manager at the Allendale Coal Company's collieries in Cumberland he came to South Wales and joined the Great Western Collieries, Limited, with which undertaking he had altogether been associated for nearly thirty years. During the period of his service these collieries made great strides, and it was in recognition of that fact that he was made a director of the company. Mr. Bramwell attained a position of eminence in the counsels of the coalowners and was chairman of the Monmouthshire and South Wales Coalowners' Association in 1915, which was a period of great responsibility in view of the important negotiations which took place at that time between the Government, the coalowners, and the workmen. He was on the Consultative Committee of Control throughout the war, and not so long ago was appointed on the Committee of Research. He was also a former president of the South Wales Institute of Engineers. It was during his year of office that the Mining Students' Associations in Glamorgan and Monmouthshire became affiliated to the Institute.

Current Business.

On the whole, the coal market bears a fairly steady appearance. The inquiry cannot be described by any means as active, but, still, bookings are on a moderately good scale and most of the leading collieries are well stemmed for the coals which they will have available this month, and they can therefore afford to decline to modify their prices. Some of the dry steam coal collieries have done more business of late than they had arranged since the national strike, and they are now in a quite comfortable position. There is a fair number of inquiries in circulation for supplies of coals for delivery over the early part of next year, but it is difficult at the moment to say whether much will come of them.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

ALTHOUGH the general demand for tin-plates is rather better, the market shows a rather easier tone. Makers are fairly well booked up to the end of January. Business is quiet in galvanised sheets, and sheets and tin bars are unaltered at £7 15s., which is the official minimum. Reports show that very little business is passing in foreign steel.

Dock Delays.

The Joint Committee of coalowners, shipowners, &c., has met to consider the question of dock delays and increased facilities for dealing with loading of vessels, and it has been decided to obtain particulars as to the loss being sustained by the trade as a result of existing arrangements.

Miners' Subsistence Allowance.

Returns so far to hand show that the proposals of the coalowners respecting their offer of a subsistence allowance to the lower-paid day wage men are far from favoured, and that the lodges are in most cases voting for the terms to be submitted to the independent chairman.

LAUNCHES AND TRIAL TRIPS.

BARRABOOL, twin-screw passenger steamer; built by Harland and Wolff, to the order of Peninsular and Oriental Steam Navigation Company's branch line service; dimensions, 529ft. by 64ft. by 41ft.; 13,300 gross tonnage. Engines, two sets quadruple engines; constructed by the builders; launch, November 3rd.

BELLBRO; built by Blythe Shipbuilding and Dry Docks Company, Limited; dimensions, 285ft. by 42ft. Engines, triple-expansion, 22in., 36in. and 60in. by 39in. stroke; constructed by North-Eastern Marine Engineering Company, Limited; trial trip, November 3rd.

KYANITE, coasting steamer; built by Yarrow and Co., Limited, to the order of Mr. Wm. Robertson, of Glasgow; dimensions, 175ft. by 28ft. by 13ft. 6in.; to carry, 800 tons deadweight on a draught of 13ft. 6in. Engines, triple-expansion, 18in., 25½in. and 41in. by 30in. stroke, pressure 180 lb. launch, November 3rd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

G.N. MOTORS, Limited, of East-hill, Wandsworth, London, S.W. 18, inform us that they have opened a show-room at 222, Great Portland-street, London, W. 1, under the management of Mr. Clifford Finch.

MESSRS. CHARLES BARRON AND CO., of Craven House, 121, Kingsway, W.C. 2, have been appointed sole agents by Combustions Limited, 24B, High-street, Kingston-on-Thames, for the sale of the "Rotomisor" liquid fuel burner, covering the areas of London, South-East England, Birmingham and district.

MESSRS. J. MITCHELL MONCRIEFF AND PARTNERS ask us to state that the address of their London office has been changed from 33, Old Jewry, London, E.C. 2, to St. Margaret's House, 57 and 59, Victoria-street, Westminster, S.W. 1. The new telephone number is Victoria 1387. The firm's Newcastle office address remains unchanged.

WE are informed that a new Monometer company has been organised in France in order to manufacture and sell under royalty basis all the Monometer productions. This company will have the sole selling rights for the whole of the French markets and French territories and the Belgium markets and Belgium territories. Similar arrangements are being made for the territories of Holland, the whole of the Scandinavian countries, Germany, Russia and Czecho-Slovakia.

THE ROYAL AGRICULTURAL SHOW.—The eighty-first annual Exhibition of the Royal Agricultural Society of England will take place at Cambridge from Tuesday, July 4th, to Saturday, July 8th, next year. The site chosen is about a mile and a quarter from the town. It lies between Trumpington-road, Long-road and the lines of the London and North-Western and Great Eastern railways, and is easy of access. It has been arranged that the 1923 Show shall be held at Newcastle-on-Tyne (for the fifth time), the 1924 Show at Leicester, and the 1925 Show at Chester.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon, the 5th inst., Sir James Crichton-Browne, Treasurer and Vice-president, in the chair. Mr. A. K. Loyd was elected a manager to fill the vacancy caused by the death of Mr. J. H. Balfour Browne; Dr. Niels Bohr (Copenhagen), Dr. Johan Hjort (Copenhagen), and Professor Paul Langevin (Paris) were elected honorary members; and Mr. W. A. F. Balfour Browne, the Dowager Countess of Carnarvon, Mr. P. C. Clifford, Mr. and Mrs. C. L. Dalziel, Major F. R. de Bertodano, Lieut.-Colonel F. J. Dewes, Mr. H. J. Eck, Mr. K. Lightfoot, Mr. W. M. Ogilvie, Mr. R. B. Ransford, and Mr. F. I. Rawlins were elected members.

KING'S COLLEGE ENGINEERING SOCIETY.—The twenty-fourth annual dinner of the King's College Engineering Society was held in the Throne Room at the Holborn Restaurant on November 25th, and a happy and successful evening was spent by a record number (160) of past and present members. The chair was occupied by Mr. J. S. Highfield, A.K.C., M. Inst. C.E., President of the Institution of Electrical Engineers, and a past member of the Society, the guest of the evening being Mr. W. B. Worthington, B.Sc., President of the Institution of Civil Engineers. The presence of the Principal (Dr. Barker), the Dean (Rev. W. Matthews), the Dean of the Faculty of Engineering (Professor Wilson) and a muster of past and present members made the gathering thoroughly representative of the Society and its associations.

CONTRACTS.—The contract for a Government icebreaker for the St. Lawrence has been awarded to Canadian Vickers, Ltd., of Montreal, the tender of which firm—1,580,000 dols.—was lowest.—We are informed that Sir William Arrol and Co., Limited, has obtained from the Crown Agents of the Colonies the order for the new railway workshops at Enugu, West Africa, for the Nigerian Railways. In addition to the buildings and power station, the order comprises the complete equipment and erection *in situ*.—The Leicester Corporation has recently placed an order with the Staveley Coal and Iron Company, Limited, of Chesterfield, for 2700 tons of 27in cast iron pipes.—We understand that the Wellman Smith Owen Engineering Corporation, Limited, of London and Darlaston, has secured a contract from the Barrow Hematite Steel Company, Limited, Barrow-in-Furness, for the crane equipment of that company's new steel works extension, including a ladle crane, charging machine, &c.

METAL TRADES' PENSION SOCIETY ANNUAL DANCE.—The annual dance of the Royal Metal Trades' Pension Society is to be held in the Victoria Hall, Hotel Cecil, on Friday, February 24th next. The whole of the proceeds of the dances are devoted to the relief of temporary distress amongst those engaged in the metal trades and their widows. The Society, it may be explained, grants permanent annuities, not exceeding 25 guineas, to necessitous members of the metal trades, sixty years of age and upwards, who have been engaged within the limits of the United Kingdom as employer, manager, traveller, agent, clerk, or salesman, or to the widows of such persons. It is the only Pension Society in the metal trades, operating over the whole of the United Kingdom, and an appeal for generous support is made, not only to members of the trade themselves, but to those outside the trade who in many ways derive benefit from its operations. The price of the tickets is one guinea, which includes a supper and light refreshments during the evening. Donations may be forwarded to Mr. Edward Le Bas at Dock House, Billiter-street, London, E.C. 3, or to the secretary, 195, Upper Thames-street, London, E.C. 4. We may add that 230 persons are now in receipt of the pension, that last year £6070 was distributed in pensions and relief, and that since the establishment of the Society 1900 persons have received assistance amounting to over £240,000.

Current Prices for Metals and Fuels.

IRON ORE.

N W. Coast—	
Native	37/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	6 5 0	—
No. 1 Foundry	6 5 0	—
No. 3 ,,	6 0 0	—
N.E. Coast—		
Hematite Mixed Nos.	5 10 0	5 10 0
No. 1	5 12 6	5 12 6
Cleveland—		
No. 1	5 5 0	5 10 0
Silicious Iron	—	—
No. 3 G.M.B.	5 0 0	5 5 0
No. 4 Foundry	4 15 0	4 15 0
No. 4 Forge	4 10 0	4 10 0
Mottled	4 5 0	4 5 0
White	4 5 0	4 5 0
Midlands.		
Staffs.—		
All-mine (Cold Blast)	15 0 0	—
Part Mine Forge	*None offering.*	
,, Foundry No. 3	*None offering.*	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 15 0 to 4 17 6	
,, Forge	4 7 6 to 4 10 0	
(3) Derbyshire—		
No. 3 Foundry	5 0 0 to 5 2 6	
Forge	4 10 0 to 4 12 6	
Lincolnshire—		
Basic	*Uncertain.*	
Foundry	,,	—
Forge	,,	—
(4) N.W. Coast—		
N. Lancs. and Cum'.		
Hematite Mixed Nos.	6 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
Scotland—		
Crown Bars	12 10 0	—
Best ,,	17 0 0	—
N.E. Coast—		
Common Bars	12 10 0	—
Marked ,,	18 0 0	—
Tees	14 10 0	—
Lancs.—		
Crown Bars	13 0 0	—
Hoops	16 5 0	16 0 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best ,,	14 0 0	—
Hoops	15 5 0	—
Midlands—		
Marked Bars (Staffs.)	16 0 0	—
Crown Bars	12 15 0 to 13 0 0	
Nut and Bolt Bars	12 12 6 to 13 0 0	
Gas Tube Strip	15 0 0	—
Hoops	16 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	14 0 0	—
Ship Plates ¾in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ⅛in. to ⅜in.	12 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 15 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	16 0 0	—
Joists	10 10 0	—
Heavy Rails	10 10 0	—
Fish-plates	15 10 0	—
Channels	14 10 0	—
Hard Billets	9 10 0	—
Soft Billets	7 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	11 0 0	—
Light ,,	13 0 0 to 15 0 0	
Billets	9 10 0	—
Ship Plates	10 10 0	—
Boiler ,,	16 0 0	—
Manchester (*Prices irregular and uncertain, unchanged*)—		
(8) Bars (Round)	10 0 0 to 12 0 0	
(8) ,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
Sheffield—		
Siemens Acid Billets	13 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	10 0 0	—
Soft ,,	8 10 0 to 10 0 0	
Hoops	13 5 0	—
Soft Wire Rods	10 0 0	—
Midlands—		
Small Rolled Bars	10 10 0	—
Bessemer Billets and Sheet Bars	8 0 0	
(2) Hoops (Soft)	12 5 0	—
Tube Strip	11 10 0	—
Sheets (24 W.G.)	15 0 0	—
Galv. Sheets (f.o.b. L'pool)	18 0 0 to 19 0 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	20/6 to 22/-
Block Tin (cash)	167 17 6
,, (three months)	169 10 0
Copper (cash)	67 5 0
,, (three months)	68 2 6
Spanish Lead (cash)	25 7 6
,, (three months)	24 12 6
Spelter (cash)	26 2 6
,, (three months)	26 15 0
Manchester—	
(9) Copper, Best Selected Ingots	70 0 0
(9) ,, Electrolytic	74 0 0
(10) ,, Strong Sheets	101 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 4½
Lead, English	26 10 0
,, Foreign	25 10 0

(*Metal prices practically unchanged*).

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£28	12/-
,, 6 p.c. to 8 p.c. ,,	£26	10/-
,, 8 p.c. to 10 p.c. ,,	£26	10/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/3 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese (per ton)	£18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	21/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	14/6 per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	Export.
Scotland.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	25/-
,, ,, Ell	26/-
,, ,, Splint	26/6 to 30/-
,, ,, Trebles	25/-
,, ,, Doubles	22/-
,, ,, Singles	17/6
Ayrshire—	
(f.o.b. Ports)—Steam	24/-
,, ,, Splint	26/6
,, ,, Trebles	25/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	20/- to 24/6
Screened Navigation	29/-
Trebles	25/-
Doubles	21/6
Singles	18/6
Lothians—	
(f.o.b. Leith)—Best Steam	23/6
Secondary Steam	23/-
Trebles	25/-
Doubles	22/6
Singles	17/6
England.	
(11) N.W. Coast—	
Steams	34/6
Household	40/- to 55/-
Coke	36/- to 39/6
Northumberland—	
Best Steams	24/- to 25/-
Second Steams	21/6 to 22/-
Steam Smalls	15/-
Unscreened	21/6
Household	25/- to 30/-
Durham—	
Best Gas	23/- to 24/-
Second	20/- to 22/-
Household	25/- to 30/-
Foundry Coke	37/6 to 40/-
Sheffield—	**Inland.**
S. Yorks. Best Steam Hards	25/- to 26/-
Derbyshire Hards	24/- to 25/-
Seconds	23/- to 24/-
Cobbles	23/- to 24/-
Nuts	22/- to 23/-
Washed Smalls	17/- to 18/-
Best Hard Slacks	17/6 to 18/6
Seconds ,,	17/- to 17/6
Soft Nutty ,,	17/- to 17/6
Pea ,,	11/6 to 12/6
Small ,,	9/- to 10/-
House, Branch	39/- to 41/-
,, Best Silkstone	37/6 to 39/-
Blast Furnace Coke (Inland and Export)	22/6 to 27/6
(12) South Wales.	
Cardiff—	
Steam Coals:	
Best Smokeless Large	25/- to 25/6
Second ,, ,,	24/6 to 25/-
Best Dry Large	25/- to 26/-
Ordinary Dry Large	24/6 to 25/-
Best Black Vein Large	23/- to 23/6
Western Valley ,,	23/- to 23/6
Best Eastern Valley Large	23/- to 23/6
Ordinary ,, ,,	21/6 to 22/6
Best Steam Smalls	17/6 to 18/6
Ordinary ,,	12/6 to 17/-
Washed Nuts	32/6 to 35/-
No. 3 Rhondda Large	27/6 to 30/-
,, ,, Smalls	19/- to 20/-
No. 2 ,, Large	23/- to 24/-
,, ,, Through	20/- to 22/-
,, ,, Smalls	15/- to 16/-
Coke (export)	37/6 to 40/-
Patent Fuel	26/- to 27/6
Pitwood (ex ship)	32/6 to 35/-
Swansea—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	52/6 to 55/-
Red Vein	47/6 to 50/-
Big Vein	55/- to 57/6
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	58/6 to 60/-
Peas	20/- to 22/-
Breaker Duff	8/- to 8/6
Rubbly Culm	11/- to 11/6
Steam Coals:	
Large	25/- to 27/6
Seconds	24/- to 25/-
Smalls	12/6 to 16/-
Cargo Through	20/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. (7) Export Prices—F.O.B. Glasgow. (8) Prices represent the real market before the *official* change was made.

(9) These prices are practically alike now. (10) Sheets reduced while other prices are advancing.

(11) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (12) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Position.

If the financial situation would show a little stability there would be plenty of work in all branches of the engineering industries, for there is scarcely a limit to the amount of business to be done in this country alone, which is being held up solely because there can be no circulation of capital until something is done to ensure an adequate security. The arrangements being made to carry out reconstruction work in the devastated regions with the help of Germany may assist in bringing about a little more activity at the engineering shops, but, on the other hand, the partial payment of the reparation indemnity in kind is not reassuring to French manufacturers. The State is buying little because it has no funds available, and the fear that Germany will not effect payments is naturally influencing the trade position generally, for if the State cannot find a way out of its financial embarrassments there will naturally be a repercussion everywhere, and this, more than anything else, is holding back capital from industrial enterprise. As soon as the horizon seems to clear there are signs of a recovery, but this spurt of confidence dies out when the payment of reparations becomes more problematical, and the exchange rate reflects the general unsatisfactory state of finance and politics. The fluctuations of hope are sufficient to show that trade and industry are ripe for a revival as soon as the situation is more settled. If capital were available the railways alone would be able to distribute considerable orders for electrification and other schemes; the construction of vast hydro-electric installations would be hastened; and the works in connection with harbour extensions and inland waterway development would help to provide a basis of industrial prosperity.

Fiscal Problems.

It is becoming more and more evident that there can be no general prosperity until something is done to unravel the tangle of international commercial exchanges produced by the methods adopted to counteract the effects of depreciated currencies in other countries. The enforcing of a specially high import tariff against those countries has not given the desired result of protecting home industries. It has failed to keep out German goods, and the makers of spring steel, for example, are protesting against a proposed reduction on that material, forgetting that while they are hoping to secure their own interests they are imperilling the interests of many other producers. It has often been complained that the system of coefficients was devised for the protection of particular industries, and that it has had no other effect but to provoke retaliation from other countries. It is sought to prove that the coefficients are not excessive and that they were applied after certain other countries had imposed higher tariffs which are regarded as a retaliation; but, as a matter of fact, the high foreign tariffs about which the French complain were imposed after the coefficients were approved and about the time they were enforced. As a means of counteracting the effects of depreciated currencies abroad there may be something to be said in their favour, but they cannot be adaptable to variations of exchange rates in different countries, and the result has been to create a state of things that is highly detrimental to French industrial interests. Following upon the retaliation, essentially French industries find themselves practically excluded from such countries as Spain and Italy, and business has become considerably restricted with others. No one is satisfied with the present fiscal policy, but in the present chaotic state of international finance no one is able to suggest anything better.

State Monopolies.

Another result of the industrial depression is to strengthen the agitation against State monopolies which are entailing an enormous loss to the country. The burden naturally falls largely upon the manufacturer. The State has fortunately made a start by disposing of the merchant fleet, which cost 1400 million francs and for which it will receive from 250 to 300 million francs. This huge loss is borne with equanimity, since it will ensure a considerable saving in the future. M. Louis Deschamps, the former Under-Secretary of State for Posts and Telegraphs, has lifted the veil and shown that in the different administrations there is a complete lack of organisation and an absence of understanding between the various departments. Instead of the monopolies realising profits and relieving taxpayers of some of their burdens, they are all run at a loss. M. Deschamps therefore urges that all the monopolies should be suppressed, except the post and telegraph services.

Public Transports.

For many years previous to the war the public transport services in Paris were run at a loss, which increased steadily every year, and when, on January 1st of the present year, the services were taken over by the Department of the Seine, which transferred them to a new company under the title of the Société des Transports en Commun de la Région Parisienne, there was some curiosity as to how the amalgamation of all the omnibus and tramway lines in Paris and the suburbs would convert the enterprise into a financial success. During the first ten months of working the motor omnibuses conveyed 200 million passengers against 135 millions in the corresponding period of last year. The receipts increased from 40 million francs to 67 million francs. On the tramways the number of passengers carried rose from 493 millions to 514 millions, and the receipts from 127 millions to 151 millions. On all the services there was an augmentation of 86 million passengers and 51 million francs, but this increased amount was more than absorbed by the higher wages paid, with the result that it will be necessary either to impose still higher fares or to obtain assistance from the State to make up for the deficit.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

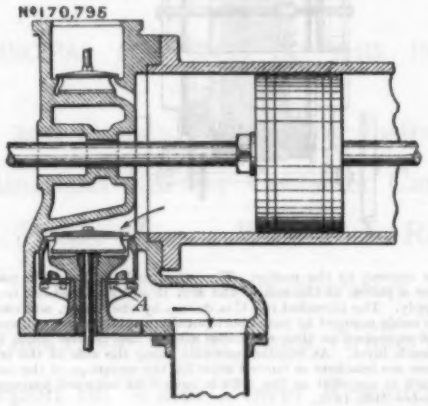
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

170,795. February 25th, 1921.—VALVE GEAR, *B. E. D. Kilburn*, 31–33, *High Holborn, London, W.C.* 1.

IT is unavoidable in steam engines working against a back pressure for the steam to expand to a pressure below that which obtains in the exhaust pipe when early cut-off occurs. In such cases, if the exhaust valve is opened in the usual manner, instead

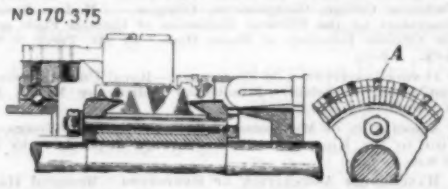


of the exhaust steam escaping from the cylinder, there is a return flow of steam into the cylinder from the exhaust pipe. Negative work is thus done during part of the stroke, thereby wasting some of the useful work done in the first part of the stroke. To avoid this difficulty a light non-return valve A is arranged below the ordinary exhaust valve.—*November 3rd*, 1921.

DYNAMOS AND MOTORS.

170,375. July 16th, 1920.—IMPROVEMENTS IN AND CONNECTED WITH DYNAMO ELECTRIC MACHINES, I. Stone and Co., Limited, of Deptford, Kent, and Alfred Edward Honey, of 31, Seymour-gardens, Ilford, Essex.

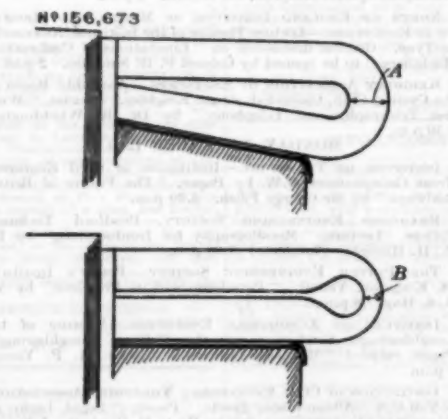
According to this invention, radiator fins or blades A are mounted in close proximity to some or all of the soldered connections of the machines and are connected, as by soldering, with



the conductors. In this way the fins or blades exercise a cooling effect on the soldered connections and prevent them melting in the event of the remainder of the machine attaining too high a temperature.—*October 17th*, 1921.

156,673. June 22nd, 1920.—IMPROVEMENTS RELATING TO THE CONSTRUCTION OF CONDUCTORS FOR ELECTRICAL MACHINES, Bergmann-Elektricitäts-Werke Aktiengesellschaft, of Seestrasse 64–67, Berlin.

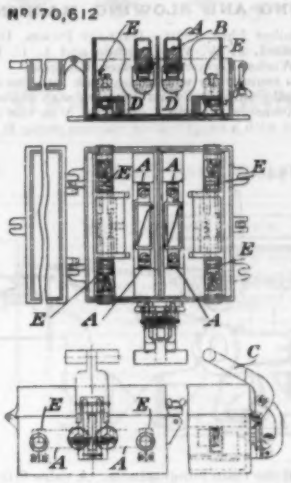
This invention relates to electrical machines in which the separate windings are formed by bending bars. The usual construction is shown in the upper drawing. According to the invention, the width of the bar is reduced as shown at B in the lower illustration.—*November 3rd*, 1921.



SWITCHGEAR.

170,612. January 22nd, 1921.—IMPROVEMENTS IN AND CONNECTED WITH ELECTRIC SWITCH FUSES, William Alexander Legge, of Hillcrest, Brook-street, Dalmuir, Scotland.

According to this invention a casing is divided into compartments, in which combined fuse cases A and current carrying switch blades B are situated. When it is desired to switch on the current the handle C is pushed towards the switch case and thus operates a double rack which turns the switch barrels D, when

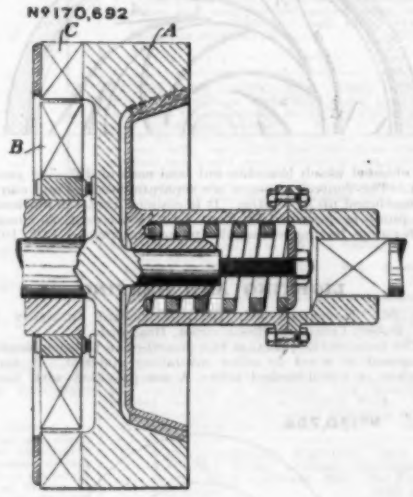


the switch blades turn and fit into sockets or clips E, thereby completing the circuit. The handle then locks the cover of the box and prevents it being opened.—*October 31st*, 1921.

MOTOR CARS AND ROAD TRAFFIC.

170,692. November 3rd, 1921.—IMPROVEMENTS RELATING TO THE TRANSMISSION OF POWER IN AND TO THE ELECTRICAL EQUIPMENT OF MOTOR VEHICLES, AIRCRAFT, AND THE LIKE, Frederick Hungerford Bowman, of 76, Acomb-street, Whitworth Park, Manchester, and Ralph Leonard Aspden, of 6, Southport-road, Chorley, Manchester.

The rotor A of a dynamo-electric machine is fixed on to the

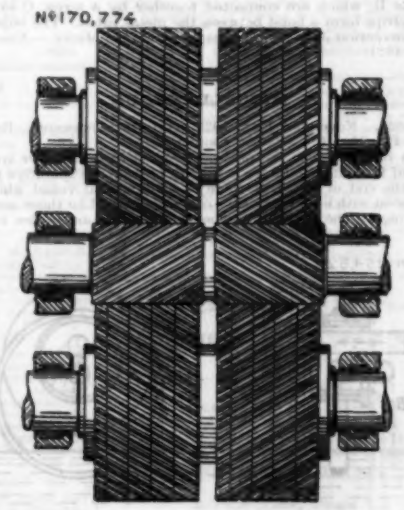


driving shaft of the vehicle in place of the fly-wheel and has a clutch incorporated in it as shown. B is the stator and C the rotor winding.—*November 3rd*, 1921.

TRANSMISSION OF POWER.

170,774. November 12th, 1920.—TOOTHED GEARING, *The British Thomson-Houston Company, Limited*, 83, *Cannon-street, London, E.C.* 4.

The gear wheels are built up of plates or discs, which are fastened together at the centre, but left slightly apart at the



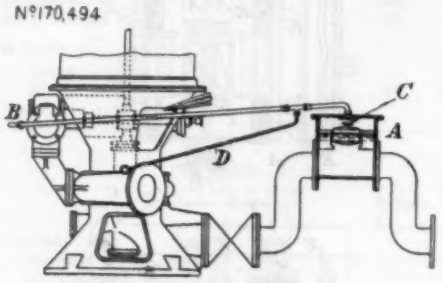
periphery, so that they may yield slightly under load and effect an equal distribution of pressure. In order that the pinion may not be worn unequally the spaces between the discs of one gear

wheel are arranged opposite the discs of the other wheel.—*November 3rd*, 1921.

PUMPING AND BLOWING MACHINERY.

170,494. October 22nd, 1920.—Ballast Pumps, Drysdale and Co., Limited, J. W. W. Drysdale and L. C. Brown, Bon Accord Works, Ferry-road, Yoker, Glasgow.

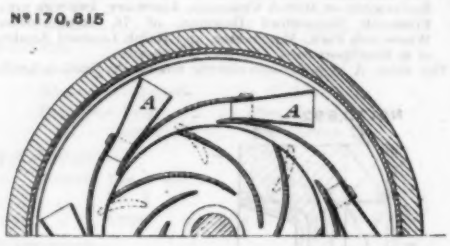
In order to remove air which may leak into the suction pipe of a centrifugal pump, and thus interfere with the action of the pump, the inventors provide a chamber A in the suction pipe and connect it with a reciprocating vacuum pump B. The pump



B is driven off the main pump spindle. A valve C is arranged in the chamber A, in connection with a float, to prevent water gaining access to the pump B. An auxiliary connection D is made from the vacuum pump to the eye of the impeller.—*October 27th*, 1921.

170,815. July 14th, 1920.—Centrifugal Pumps, O. A. Price, Lloyd's Bank Chambers, Lincoln.

The inventor claims that the form of construction illustrated facilitates the adaptation of standard pumps to varying requirements and makes possible the economical machining of the water passages. Round the periphery of the impeller there is a collect-

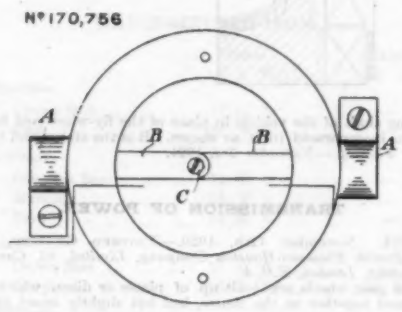


ing channel which branches out into conical diffusion passages A A. The conical passages are separate castings and can thus be machined up in a lathe. It is claimed that the efficiency of the pump is improved by from 2 to 2½ per cent. as compared with pumps having rectangular passages.—*October 14th*, 1921.

LIGHTING AND HEATING.

170,756. November 3rd, 1921.—Electric Junction Box, Robert Crust, 40, Brook-street, Bradford.

The body of the junction box described in the specification is composed of wood or other insulating material. A suitable number of metal-bushed inlets A are provided with bonding

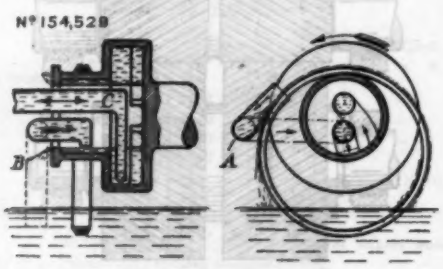


strips B, which are connected together by a screw C so that the strips form a bond between the metal tubes. The object of the invention is to secure cheapness and simplicity.—*November 3rd*, 1921.

MISCELLANEOUS.

154,529. November 17th, 1920.—Liquid Governors, Brown, Boveri et Cie., Baden, Switzerland.

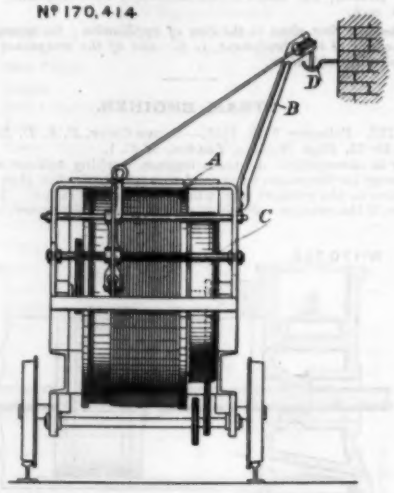
In this governor the pressure created in an annular ring of liquid by centrifugal force is used to provide the operative force. On the end of the shaft there is a cylindrical vessel which is supplied with liquid by means of a ring acting like those used for bearings. The liquid is scraped off the ring and taken to the



cylindrical vessel by the pipe A. Surplus liquid escapes over the lip B. The dip pipe C reaches out to the outside of the annular ring of liquid and conveys its pressure to the regulating device.—*November 3rd*, 1921.

170,414. July 24th, 1920.—Improvements in Methods of and Apparatus for Conveying Electric Current to a Movable Truck or the Like, Hugh Reginald Lamb and Harold Huartson, both of Saltley Gasworks, Birmingham.

The electric truck described in this specification is provided with a drum A, which carries a flexible cable for the supply of current to the motor, one end of the cable being attached to a slip ring and a brush rubbing on this ring serves for conveying



the current to the motor. The other end of the cable passes over a pulley at the end of the arm B and is connected to the supply. The threaded rod C is driven by the motor, and causes the cable support to move horizontally as the cable is unwound and re-wound so that the cable always lies on the drum in a smooth layer. At regular intervals along the side of the track there are brackets or curved arms for the reception of the cable, which is uncoiled as the vehicle covers its outward journey.—*October 24th*, 1921.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Mechanical Engineers.—Storey's-gate, Westminster. Informal meeting. Discussion, "Ball and Roller Bearings: Some Recent Types and Criticisms," continued from last session. 7 p.m.

West of Scotland Iron and Steel Institute.—24, Royal Technical College, George-street, Glasgow. "Modern Steam Generators for the Efficient Utilisation of Gaseous Fuels and the Efficient Recovery of Waste Heat," by Mr. Percy S. G. Kirk. 7 p.m.

Junior Institution of Engineers.—Royal United Services Institution, Whitehall. Presidential address by Mr. C. H. Wordingham. 7.30 p.m.

Association of Managers of Sewage Disposal Works.—Visit to the Kingston-on-Thames sewage disposal works at 11 a.m.

Manchester Association of Engineers.—Memorial Hall, Albert-square, Manchester. Paper: "The Water Power of Great Britain and the Empire," by Sir Dugald Clerk. 7 p.m.

Association of Engineering and Shipbuilding Draughtsmen: Merseyside Branch.—University Engineering Building, Liverpool. "The Future Relations between Great Britain, Japan and U.S.A.," by Mr. C. C. Stevenson. 7.30 p.m.

SATURDAY, DECEMBER 10th.

Scientific Society of the Royal Technical College, Glasgow.—Lecture: "Water Turbines," by Mr. D. M. Anderson. 7.30 p.m.

Manchester Geological and Mining Society.—Visit to the Pilkington Special Hospital, St. Helens. 2 p.m.

North of England Institute of Mining and Mechanical Engineers.—Lecture Theatre of the Institute, Newcastle-on-Tyne. General discussion on "Limitations of Coal-cutting Machinery," to be opened by Colonel F. R. Simpson. 2 p.m.

Keighley Association of Engineers.—Assembly Room of the Cycling Club, Cavendish-street, Keighley. Lecture, "Wireless Telegraphy and Telephony," by Dr. R. Whiddington. 6.30 p.m.

MONDAY, DECEMBER 12th.

Institute of Transport.—Institution of Civil Engineers, Great George-street, S.W. 1. Paper, "The Future of British Railways," by Sir George Paish. 5.30 p.m.

Bradford Engineering Society.—Bradford Technical College. Lecture, "Metallography for Ironfounders," by Dr. W. H. Hatfield. (Lantern.) 7.30 p.m.

The Petter Engineering Society.—Petter's Institute, 28, Kingston, Yeovil. "Petroleum and its Products," by Mr. G. S. Hay. 8 p.m.

Institute of Automobile Engineers.—Meeting of the Loughborough Graduates, at the College, Loughborough. Paper, entitled "Magneto Ignition," by Mr. A. P. Young. 7 p.m

Institution of Civil Engineers: Yorkshire Association.—Y.M.C.A., Albion-place, Leeds. Paper, "Legal Light on Engineering Embarrassments," by Mr. C. H. Plackett. 7.30 p.m.

TUESDAY, DECEMBER 13th.

The Faraday Society.—Rooms of Chemical Society, Burlington House, W. 1. Annual general meeting. Address on "The Structure of Some Gaseous Molecules," by Professor A. O. Rankine. To be followed by a discussion. 7.45 p.m.

Manchester Metallurgical Society.—The College of Technology, Manchester. "White Metals," by Mr. A. H. Munday. 7 p.m.

The Institution of Electrical Engineers: Scottish Centre.—The Rooms, 207, Bath-street, Glasgow. Paper, "The Cye-Arc Process of Automatic Electric Welding," by Messrs. L. J. Steel and H. Martin. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Papers, "Deep-water Quays: General Considerations of Design," by Mr. Ernest Latham; "On the Stability of Deep-water Quay Walls," by Mr. F. E. Wentworth-Sheilds. 6 p.m.

Institution of Automobile Engineers.—Meeting of the Coventry Graduates, at the Broadgate Café, Coventry. Paper, "General Motor Cycle Design," by Mr. C. Ballard. 7.45 p.m.

Illuminating Engineering Society.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Discussion, "Progress in Gas Lighting in relation to Illuminating Engineering," to be opened by Mr. W. J. Sandeman. 8 p.m.

Manchester Geological and Mining Society.—Queen's Chambers, 5, John Dalton-street, Manchester. Lantern demonstration on "The History of a Colliery Cable: From Factory to Face," by Mr. W. T. Anderson. 4 p.m.

Institute of Marine Engineers.—The Minories, Tower-hill, E. "The Problem of Grey Iron Castings," by Mr. H. J. Young. 6.30 p.m.

The Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "White Metals," by Mr. G. E. Fleming. 7.30 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, W.C. 2. "Better Production Methods," by Mr. A. Frank Dabell. 5.30 p.m.

WEDNESDAY, DECEMBER 14th.

Institution of Automobile Engineers.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Paper, "Motor Car Gear-boxes," by Mr. H. F. L. Orcutt. 8 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington. Discussion on "Visibility," to be opened by Mr. F. J. W. Whipple. 5 p.m.

Liverpool Engineering Society.—Royal Institution, Colquitt-street, Liverpool. "Mechanical Cargo Handling," by Mr. G. Rae. 8 p.m.

Thornycroft Engineering Society.—Works Canteen, Basingstoke. "Marine Motors," by Mr. T. Thornycroft. 7 p.m.

Association of Engineers-in-Charge.—St. Bride's Institute, Bride-lane, Fleet-street, E.C. 4. Paper, "Utilisation of Exhaust Gases from Internal Combustion Engines," by Major W. Gregson. 7.30 p.m.

Institution of Automobile Engineers.—Meeting of the North of England Centre, at the Assembly Room, Education Offices, Salford, Manchester. Paper, "Steering Gears," by Mr. F. G. Jagger. 7.30 p.m.

Industrial League and Council.—Caxton Hall, S.W. Lecture, "The Cost of Living and its Implications," by Mr. H. G. Williams.

Society of Glass Technology.—Chemistry Lecture Theatre, University College, Gower-street, W.C. 1. (*a*) "Note on Pipettes," by Mr. Verney Stott; (*b*) "Measuring Small Variations of Refractive Index throughout Meltings of Optical Glass," by Messrs. A. J. Dalladay and F. Twyman; (*c*) "On the Annealing of Glassware and on Annealing without Pyrometers," by Mr. F. Twyman. 2.45 p.m.

Association of Drop Forgers and Stampers.—Mappin Hall, Sheffield. Lecture, "The Testing of Drop Forgings," by Dr. Leslie Aitchison. 7.30 p.m.

THURSDAY, DECEMBER 15th.

Institution of Mechanical Engineers.—Annual Dinner, Connaught Rooms. 7.15 p.m.

The Newcomen Society.—Large Theatre, King's College, Strand, W.C. 2. Annual general meeting. Paper, "Greek and Roman Engineering Instruments," by Mr. R. C. S. Walters. (Lantern.) 5 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. "Induction Type Synchronous Motors," by Mr. L. H. A. Carr. 6 p.m.

Royal Aeronautical Society.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Lecture, "The Development of the Fighting Aeroplane," by Captain F. M. Green. 5.30 p.m

The Concrete Institute.—Denison House, 296, Vauxhall Bridge-road, Westminster, S.W. 1. Papers:—(*a*) "The Preparation of Concrete Aggregates" and (*b*) "Moving Forms" (lantern), by Mr. E. F. Sargeant. 7.30 p.m.

Institution of Automobile Engineers.—Meeting of the London Graduates, at 28, Victoria-street, London, S.W. 1. Paper, "The Design of Automobile Clutches," by Mr. E. Chatterton. 8 p.m.

FRIDAY, DECEMBER 16th.

Junior Institution of Engineers.—Caxton Hall, S.W. 1. "Notes on Searchlight Construction and Operation," by Mr. A. J. Simpson. 8 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. "Conveying and Elevating Machinery," by Mr. Gardiner Mitchell; "Discharge of Grain Cargoes in the Port of London by Pneumatic Elevators," by Mr. R. E. Knight. 6 p.m.

Manchester Association of Engineers.—Memorial Hall, Albert-square, Manchester. President's Conversazione. 7 p.m.

Institute of Transport: Graduates and Students.—The Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Operation of a Road Distributing Agency," by Mr. J. Paterson. 5 p.m.

Institution of Locomotive Engineers (Scottish Centre).—Royal Technical College, Glasgow. "Steel for Locomotive Purposes," by Sir Henry Fowler. 7.30 p.m.

SATURDAY, DECEMBER 17th.

Institution of Automobile Engineers.—Visit of the London Graduates to the works of G. N., Limited, East-hill, Wandsworth, S.W. Meet outside the works at 2.30 p.m.

MONDAY, DECEMBER 19th.

Institution of Automobile Engineers.—Meeting of the Scottish Centre, at the Royal Technical College, Glasgow. Paper, "Tubes," by Mr. W. W. Hackett. 7.30 p.m.

TUESDAY, DECEMBER 20th.

Institution of Automobile Engineers.—Ordinary general meeting of the Institution, at the Broadgate Café, Broadgate, Coventry. Paper, "Motor Car Gear Boxes," by Mr. H. F. L. Orcutt. 7.45 p.m.

WEDNESDAY, DECEMBER 21st.

Institution of Automobile Engineers.—Meeting of the Birmingham Graduates, at the Chamber of Commerce, New-street, Birmingham, when a debate will be held on "Motor Cycle and Sidecar *v.* the Small Car." Graduates of other branches and visitors are invited. 7.30 p.m.